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U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION V

EPA CONTRACT NO.: 68-01-6939
WORK ASSIGNMENT NO.: 61-5117.0

SAMPLING AND ANALYSIS PLAN
FOR
AMERICAN CHEMICAL SERVICE, INC.
GRIFFITH, INDIANA

REM II

PERFORMANCE OF REMEDIAL RESPONSE ACTIVITIES AT UNCONTROLLED HAZARDOUS WASTE SITES

U.S. EPA CONTRACT NO. 68-01-6939

CAMP DRESSER & McKEE INC.
ROY F. WESTON, INC.
WOODWARD-CLYDE CONSULTANTS
CLEMENT ASSOCIATES, INC.
ICF INCORPORATED
C. C. JOHNSON & ASSOCIATES, INC.

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SAMPLING AND ANALYSIS PLAN FOR AMERICAN CHEMICAL SERVICE, INC. GRIFFITH, INDIANA

JUNE 1987

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TABLE OF CONTENTS

SAMPLING AND ANALYSIS PLAN
AMERICAN CHEMICAL SERVICE, INC., GRIFFITH, INDIANA

TABLE OF CONTENTS

SAMPLING AND ANALYSIS PLAN
AMERICAN CHEMICAL SERVICE, INC., GRIFFITH, INDIANA

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

SECTION 1

INTRODUCTION

1.1 OBJECTIVES OF SAMPLING PROGRAM

The objectives of the sampling program to be implemented as part of the RI/FS at the American Chemical Service site in Griffith, Indiana, are as follows:

- o To determine and characterize the location, nature and volume of the contaminated areas on site including the Still Bottoms Pond, Treatment Pond 1, Kapica Dump Site, the On-Site Drum Containment Area, and the Off-Site Drum Containment Area. Also included in the sampling program is monitoring well installation at the suspected waste disposal area in the Griffith Landfill.
- o To determine the details of on-site soil stratigraphy and the stratigraphy of adjacent off-site areas.
- o To determine the hydrogeologic conditions in the upper aquifer and the water supply aquifer including vertical and horizontal groundwater flow conditions on site and in adjacent off-site areas.
- o To determine the configuration of the water table in the upper aquifer and the potentiometric surface in the water supply aquifer on site and in adjacent downgradient areas off site.
- o To identify surficial drainage features and flow patterns, and characterize the relationship of surface water to groundwater on site and in adjacent off-site areas.
- o To characterize the extent and migration of gorundwater contamination in the upper aquifer and in the water supply aquifer on site and in adjacent off-site areas.
- o To characterize the extent of surface water and sediment contamination on site and in adjacent off-site areas.
- o To determine if groundwater currently being pumped by private wells within one mile of the site is contaminated.

1.2 SCOPE OF SAMPLING ACTIVITIES

The scope of sampling activities in this plan includes the installation of 39 groundwater monitoring wells, drilling of 14 soil and waste borings, trenching of 6 waste pits, and collection and analysis of 341 samples. Chemical analysis to detect priority pollutants and other hazardous materials will be performed on 252 samples, of which 221 are investigative, 23 are duplicates, and 11 are blanks. Geotechnical index properties will be determined for 78 samples, including 8 field duplicates, to characterize on-site soil materials. The environmental media to be sampled include groundwater, surface water, sediment, soil and private water wells. Waste will also be collected and sampled. A summary of sampling effort is summarized in Table 1-1, and the sampling and analysis program is presented in detail in Table 1-2.

TABLE 1-1

Summary of Sampling Effort

	Investigative	Duplicate	Blank
Waste Pit (WP)	18	2	0
Natural Soil-Pit (NP)	6	1	0
Waste Boring (WB)	34	3	0
Natural Soil-Boring (NB)	8	1	0
Soil Area (SA)	16	2	0
Soil Boring (SB)	18	2	0
Groundwater (GW) I filtered	39	4	4
I unfiltered	10	1	1
II filtered	20	2	2
II unfiltered	5	1	1
Surface Water (SW) unfiltered	9	1	1
Sediment (SD)	9	1	0
Private Wells (PW)	25	2	2
Subtotals			
Soil/Sediment	111	12	0
Liquid	110	11	11
Subtotal	221	23	11
Chemical Subtotal	255		
Geotechnical*	78	8	-
Geotechnical Subtotal	86		
Grand Total	341		

* Samples for geotechnical testing will be collected during monitoring well installation.

TABLE 1-2

SUMMARY OF SAMPLING AND ANALYSIS PROGRAM

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples			QA Samples						Matrix Total
						Duplicate			Blank			
			No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Waste Pits (Med)	Qualitative organic vapor screening with OVA and HNu	RAS organics package from CLP including 30 tentatively identified parameters	18	1	18	2	1	2	0	0	0	20
		RAS inorganics package/metals and cyanide from CLP	18	1	18	2	1	2	0	0	0	20
Natural Soils-Waste Pits (Low)	Qualitative organic vapor screening with OVA and HNu	RAS organics package from CLP including 30 tentatively identified parameters	6	1	6	1	1	1	0	0	0	7
		RAS inorganics package/metals and cyanide from CLP	6	1	6	1	1	1	0	0	0	7
Waste Borings (Med)	Qualitative organic vapor screening with OVA and HNu	RAS organics package from CLP including 30 tentatively identified parameters	34	1	34	3	1	3	0	0	0	37
		RAS inorganics package/metals and cyanide from CLP	34	1	34	3	1	3	0	0	0	37

Note: Field parameters determined for investigative and duplicate samples only

TABLE 1-2 (continued)

SUMMARY OF SAMPLING AND ANALYSIS PROGRAM

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples No.	Investigative Samples Freq.	Investigative Samples Total	QA Samples Duplicate No.	QA Samples Duplicate Freq.	QA Samples Duplicate Total	QA Samples Blank No.	QA Samples Blank Freq.	QA Samples Blank Total	Matrix Total
Natural Soils-Waste Borings (Low)	Qualitative organic vapor screening with OVA and HNu	RAS organics package from CLP including 30 tentatively identified parameters	8	1	8	1	1	1	0	0	0	9
		RAS inorganics package/metals and cyanide from CLP	8	1	8	1	1	1	0	0	0	9
Soil Areas (Low)	Qualitative organic vapor screening with OVA and HNu	RAS organics package from CLP including 30 tentatively identified parameters	16	1	16	2	1	2	0	0	0	18
		RAS inorganics package/metals and cyanide from CLP	16	1	16	2	1	2	0	0	0	18
Soil Borings (Med)	Qualitative organic vapor screening with OVA and HNu	RAS organics package from CLP including 30 tentatively identified parameters	18	1	18	2	1	2	0	0	0	18
		RAS inorganics package/metals and cyanide from CLP	18	1	18	2	1	2	0	0	0	18

TABLE 1-2
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples			QA Samples: Duplicate			QA Samples: Blank			Matrix Total
			No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Groundwater (low)	pH	RAS organics package from CLP (except VOA) including 30 tentatively identified parameters	40	1.5	60	4	1.5	6	4	1.5	6	72
		SAS VOA analysis from CLP (low detection limit)	40	1.5	60	4	1.5	6	4	1.5	6	72
	Specific conductance	RAS inorganics package/metals from CLP filtered samples	40	1.5	60	4	1.5	6	4	1.5	6	72
	Temperature	RAS inorganics package/metals and SAS for suspended solids-unfiltered samples	10	1.5	15	1	1.5	2	1	1.5	2	19
		RAS inorganics package/cyanide from CLP filtered samples	40	1.5	60	4	1.5	6	4	1.5	6	72
		SAS for Alkalinity, Chloride, Fluoride Sulfate, TDS	40	1.5	60	4	1.5	6	4	1.5	6	72
		SAS for Ammonia, Nitrate-Nitrite, COD	40	1.5	60	4	1.5	6	4	1.5	6	72
Surface Water (low)	pH	RAS organics package from CLP including 30 tentatively identified parameters	11	1	11	1	1	1	1	1	1	13
	Specific conductance	RAS inorganics package/metals from CLP unfiltered samples	11	1	11	1	1	1	1	1	1	13
	Temperature	RAS inorganics package/cyanide from CLP unfiltered samples	11	1	11	1	1	1	1	1	1	13
		SAS for Alkalinity, Chloride, Fluoride Sulfate, TDS, TSS	11	1	11	1	1	1	1	1	1	13
		SAS for Ammonia, Nitrate-Nitrite, COD	11	1	11	1	1	1	1	1	1	13
Sediment (low)	Qualitative organic vapor screening with OVA and HNu	RAS organics package from CLP including 30 tentatively identified parameters	11	1	11	1	1	1	--	--	--	12
		RAS inorganics package/metals and cyanide from CLP	11	1	11	1	1	1	--	--	--	12

Note: Field parameters determined for investigative and duplicate samples only.
At U.S.EPA's request, round 2 groundwater sampling may be increased to 100% of the monitoring wells instead of 50% as shown on this table.

TABLE 1-2 (continued)
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM

			Investigative Samples			QA Samples						
						Duplicate			Blank			Matrix
Sample Matrix	Field Parameters	Laboratory Parameters	No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	Total
Private Wells (Low)	pH	Acid extractables and base/neutral extractables from CRL	25	1	25	2	1	2	2	1	2	29
	Specific conductance	Pesticides and PCBs from CRL	25	1	25	2	1	2	2	1	2	29
	Temperature	Volatile organics from CRL	25	1	25	2	1	2	2	1	2	29
		Metals from CRL - unfiltered samples	25	1	25	2	1	2	2	1	2	29
		Mercury from CRL - unfiltered samples	25	1	25	2	1	2	2	1	2	29
		Cyanide from CRL - unfiltered samples	25	1	25	2	1	2	2	1	2	29
		Minerals from CRL (alkalinity, chloride, fluoride, sulfate, TDS)	25	1	25	2	1	2	2	1	2	29
		Nutrients from CRL (ammonia, Nitrate-Nitrite, COD)	25	1	25	2	1	2	2	1	2	29
Soil-Wells (Low)	Qualitative organic vapor screening with OVA and HNU	Atterburg Limits (ASTM D 4318-83)	18	1	18	2	1	2	0	0	0	20
		Particle Size Analysis (ASTM D 422-63) Sieve analysis and hydrometer analysis	18	1	18	2	1	2	0	0	0	20
		Coefficient of permeability (ASTM D 2434-68)	18	1	18	2	1	2	0	0	0	20
		Cation exchange capacity (ASTM D 4319-83)	18	1	18	2	1	2	0	0	0	20
		Moisture content (ASTM D 2216-80)	18	1	18	2	1	2	0	0	0	20

Note: Field parameters determined for investigative and duplicate samples only.
ASTM methods can be found in American Society of Testing and Materials 1984 Annual Book of Standards, Volume 4.08, Soil and Rock; Building Stones.
Laboratory testing to be performed by a [illegible]ied geotechnical laboratory.

SECTION 2

SAMPLE LOCATIONS AND RATIONALE

There is insufficient data regarding the volume, concentration, and character of waste disposed at the American Chemical Service (ACS) site. ACS has provided some information on the approximate location and general nature of waste disposal on-site, but additional data are needed. Therefore, an investigation of the major disposal sites (the Still Bottoms Pond and Treatment Pond 1, the On-Site Drum Containment Area, the Off-Site Drum Containment Area, and the Kapica Dump Site) will be completed. This will involve sampling of the waste and the natural soil materials underlying the waste. There is also evidence that waste material has been spilled or dumped on the ground in the old Drum Storage Area and possibly within the Kapica Drum (now Pazmey Drum) property. Investigation of these areas will involve sampling of surficial and subsurface soils for characterization of residual contamination. In addition a monitoring well will be installed at the suspected waste disposal location at the Griffith Landfill. See Figure 2-1 and Table 2-1 for locations.

The most significant migration pathway at the ACS site is groundwater -- particularly in the upper aquifer, which begins at the ground surface. In 1982, four test wells were installed by FIT. A groundwater sample collected from one of these wells (Test Well 1) was found to contain substantial amounts of organic chemicals, including benzene, toluene, and trichloroethylene. Monitoring wells, sampled soil borings, water level measurements, permeability tests, and geotechnical testing of soil samples will be used to characterize this migration pathway. It is also possible that contaminants are migrating from the site via surface water, either by direct runoff or as a result of groundwater discharge to surface water bodies. Contamination accumulation in sediments could be occurring as well. These environmental media will be sampled and tested for hazardous chemicals. Private water supply wells within one mile of the site will be sampled as a precaution for protection of the public health and to provide information regarding the presence and extent of contamination in the lower aquifer, which is the main aquifer used for water supply in the area.

2.1 WASTE AND NATURAL SOIL SAMPLES FROM TEST-PITS (PHASE I)

Three source areas are known to contain considerable numbers of buried drums -- the On-Site Drum Containment Area, the Still Bottoms Pond, and Treatment Pond 1. See Figure 2-1 and Table 2-1 for locations. In two of these areas (Still Bottoms Pond and Treatment Pond 1), the drums were dumped, crushed and compacted and it is expected that fill materials will consist of a mixture of waste residue and drum carcasses. Test-pits will be used to profile the materials in these areas and to allow collection of waste samples and soil samples from at least one foot into natural soil. The approximate locations of the

TABLE 2-1

AMERICAN CHEMICAL SERVICE, INC., SITE
Disposal Locations and Waste Types

Location	Classification	Waste Types
American Chemical Service Inc. Property Off-Site Containment Area (Figure 2-1/Location C)	Documented Waste Disposal Location	Drums of PCB contaminated waste 10,000 cubic yards of distillation bottoms (drummed) Drums containing solidified materials 68 cubic yards of incinerator ash Chlorinated solvents Acetone MEK still bottoms Cresylic acid, cyanide and chromium from plating operation Lead pigments Several hundred cases of empty bottles that had contained 2,4,D and 2,4,5-TP Tank truck containing 500 gallons of solidified paint 200 drums containing solvent solids of benzene, amylacetate, dimethyl aniline, diethylether.
On-site containment area (Figure 2-1/Location E)	Documented Waste Disposal Location	400 drums of sludge and semi-solids of unknown type

TABLE 2-1
(CONT')

Location	Classification	Waste Types
Old still bottoms pond (Figure 2-1/Location F)	Documented Waste Disposal Location	253,510 gallons and 2,000 drums of still bottom sludge, containing 1,1,1-trichloroethane, trichloroethylene, methylene, chloride, toluene, benzene and other low boiling point solvents.
Treatment Pond Number 1 (Figure 2-1/Location G)	Documented Waste Disposal Location	200 drums containing solvent solids of benzene, amylacetate, dimethyl aniline, diethylether 41,612 gallons and 1,000 drums containing semi-solid paint, lacquer and ink waste
Kapica Drum, Inc. drum draining area (Figure 2-1/Location L)	Suspected Soil Contamination Location	Drum residue and drum rinse water from drum recycling operation
Old drum storage area (Figure 2-1/Location M)	Suspected Soil Contamination Location	Suspected soil contamination from unknown waste type
Old wastewater trenches (Figure 2-1/Locations, I, J, K)	Suspected Soil Contamination Location	Suspected soil contamination from wastes containing 1,1,1-trichloroethane, trichloroethylene, methylene chloride, toluene, benzene and other low boiling point solvents

TABLE 2-1
(CONT')

Location	Classification	Waste Type/Quantity
Kapica Drum, Inc. Property (Figure 2-1/Location O)	Suspected Soil Contamination Location	Suspected soil contamination from drum residue and drum rinse water from drum recycling operation
Griffith Landfill Property (Figure 2-1/Location D)	Suspected Waste Disposal Location	10 gal/week for 12 years of retained samples containing hazardous substances 2,500 drums of residues from drum recycling operation

test pits are shown in Figure 2-1 (Locations 1-3). If a liner is encountered, excavation will cease. The liner shall not be penetrated. One pit will be sufficient in the On-Site Drum Containment Area (Location 1), two pits are needed in the Still Bottoms Pond (Location 2) (parts of which now have process structures built on top), and three will be needed in the Treatment Pond No. 1 area (Location 3). In each test pit, three waste samples and one natural subsoil sample will be collected. This sampling in conjunction with geophysical studies will provide data for evaluating the volume, concentration, and character of the wastes in these source areas. Data will also provide the basis for assessing the extent to which the wastes are moving into adjacent soil materials.

2.2 WASTE AND NATURAL SOIL SAMPLES FROM BORINGS (PHASE I)

Test borings will be used to collect waste and natural soil samples in two of the source areas -- the Off-Site Drum Containment Area, and the Kapica Dump Site (see Figure 2-1). Although there is evidence of a substantial number of drums buried in the Off-Site Drum Containment Area, borings are proposed (rather than test pits) because there is a clay cap over the area and it seems likely that the drums are not densely packed. It is anticipated that the drums disposed of in this area were crushed and the fill materials will consist of a mixture of waste residues and drum carcasses. Thus, there should be less damage to the integrity of the cap with a good probability of successfully defining the extent of contamination. The approximate locations of the test borings are shown in Figure 2-2 (Locations 4 and 5). Five borings will be drilled in the Off-Site Drum Containment Area (Location 4) with five waste samples and one natural soil sample collected in each boring. Three borings are planned for Kapica Dump Site (Location 5), which apparently consists of alternating layers of drum sludges and soil. Three waste samples and one natural subsoil sample will be collected from these borings. This sampling will provide data for evaluating the volume, concentration and character of the wastes in these source areas and for assessing the extent to which the wastes are moving into adjacent soil materials.

If the magnetometer survey or attempted boring indicate that test borings will not be possible, it will be necessary to excavate test pits as described in Section 2.1 above.

2.3 SOIL AREA SAMPLES (PHASE I)

In both the ACS Old Drum Storage Area and the former Kapica Drum property (see Figure 2-1), there is evidence indicating that minor drips, spills and leaks of various chemical substances did or could have occurred. Resulting residual contamination of the unsaturated zone, if there is any remaining at this time, would be dispersed throughout relatively large areas. Composite soil samples will be used to provide a general characterization of any residual contamination in these potential source areas. The approximate

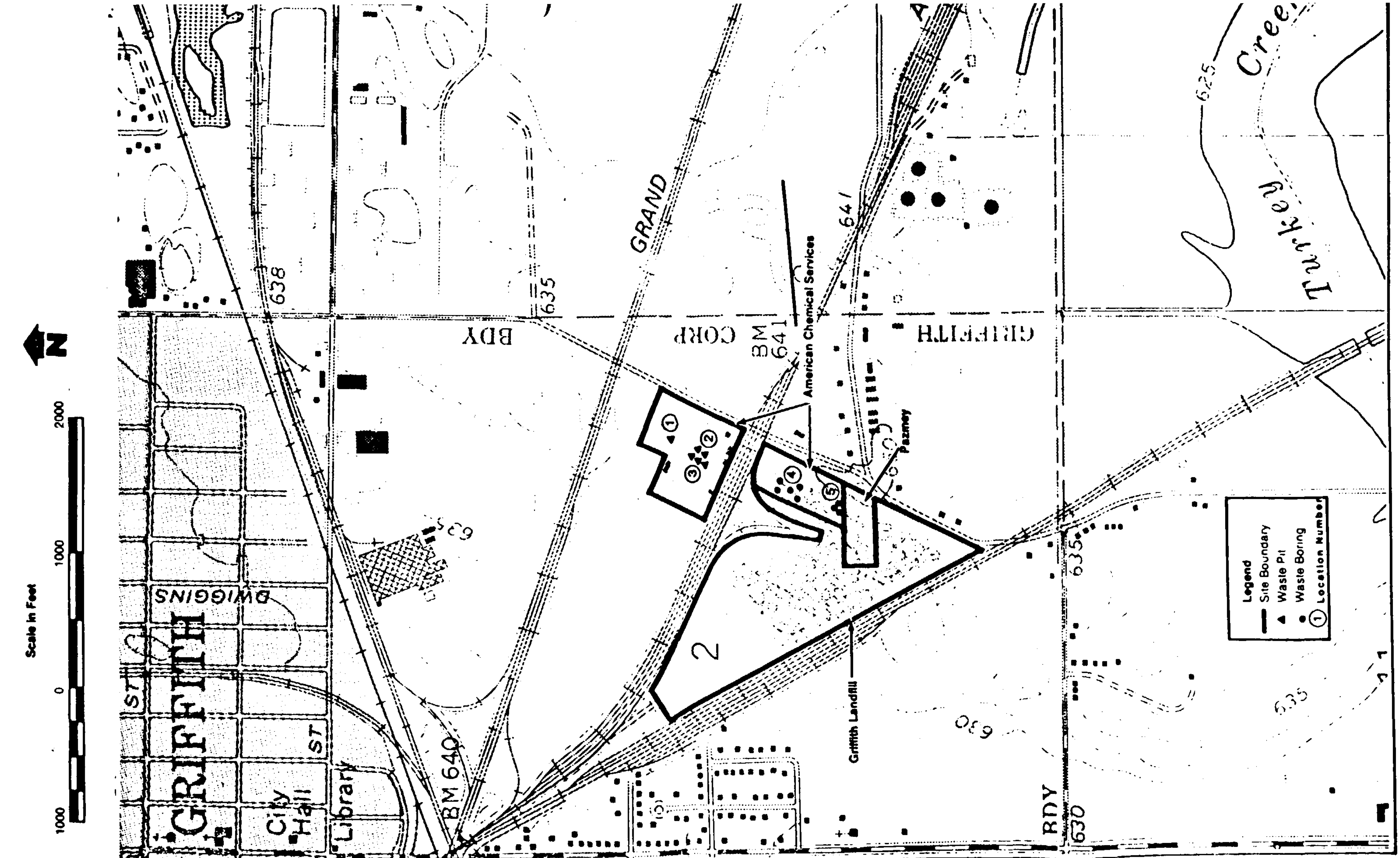


FIGURE 2-2 WASTE PIT AND WASTE BORING LOCATION

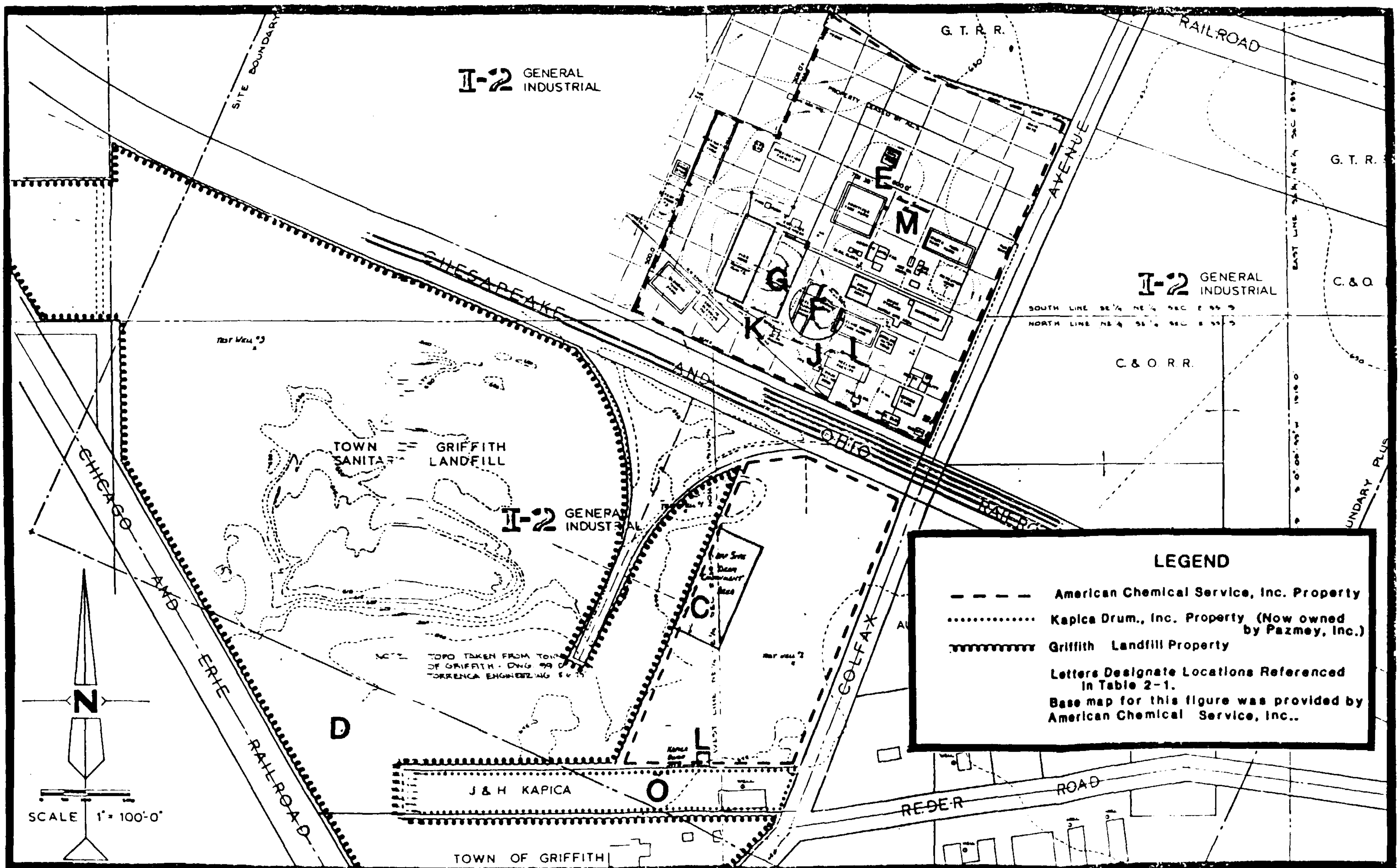


FIGURE 2-1 REMEDIAL INVESTIGATION SITES
American Chemical Service, Inc. Work Plan

locations of the sampling areas for the soil area samples are shown in Figure 2-3 (Locations 1-4). The Old Drum Storage Area will be divided into four sampling areas (Location 1) and the former Kapica Drum property will be divided into two sampling areas (Location 2). Within each sampling area, soil will be collected at five discrete sites at two depth intervals — 6 to 12 inches and 18 to 24 inches. Each soil sample will be qualitatively screened for organic vapors using HNu or OVA. Samples will be composited by depth within each sampling area. In addition to these composite samples, grab samples will be collected at two specific areas — near the former fume incinerator (Location 3) and at the site of a previous spill/fire (Location 4) — at the same depth intervals. The exact location of the fume incinerator and of the spill/fire site will be specified by American Chemical Service.

2.4 SOIL BORING SAMPLES (PHASE I)

Specific data regarding the vertical distribution of residual soil contamination in the Old Drum Storage Area (see Figure 2-1) is needed to complement the general data regarding areal extent obtained from the soil area samples. This data will be collected using six vertically sampled soil borings. The approximate locations of the soil boring samples are shown in Figure 2-3 (Location 5). The borings will be located on the basis of qualitative organic vapor screening performed during soil area sampling so that attenuation profiles can be developed for a range of near-surface contaminant conditions. In each soil boring, samples from depths of 1-1.5 feet, 2-2.5 feet and 4-4.5 feet will be submitted to the laboratory for chemical analysis.

2.5 MONITORING WELLS AND GROUNDWATER SAMPLES (PHASE I AND II)

Regional groundwater flow in the vicinity of the ACS site is reportedly to the northeast; however, due to several features near the site, flow patterns on site are not well defined. A small creek is located one-half mile to the south and the only other major surface water body is the Little Calumet River, three miles to the north. Therefore, there may be a local drainage divide through or to the north of the site. Griffith Landfill has also excavated 30 feet of soil material and is pumping to control the inflowing water, which will also affect local groundwater flow.

Based on existing subsurface data, the hydrostratigraphy at the site appears to consist of:

- o An upper aquifer fine- to coarse-grained sand with fine to coarse gravel, and small amounts of peat and silt, about 20-feet thick

- o An intervening silty clay to clay unit containing discontinuous lenses of gravel, 15 to 30-feet thick

- o A lower sand and gravel aquifer, 90-feet thick.

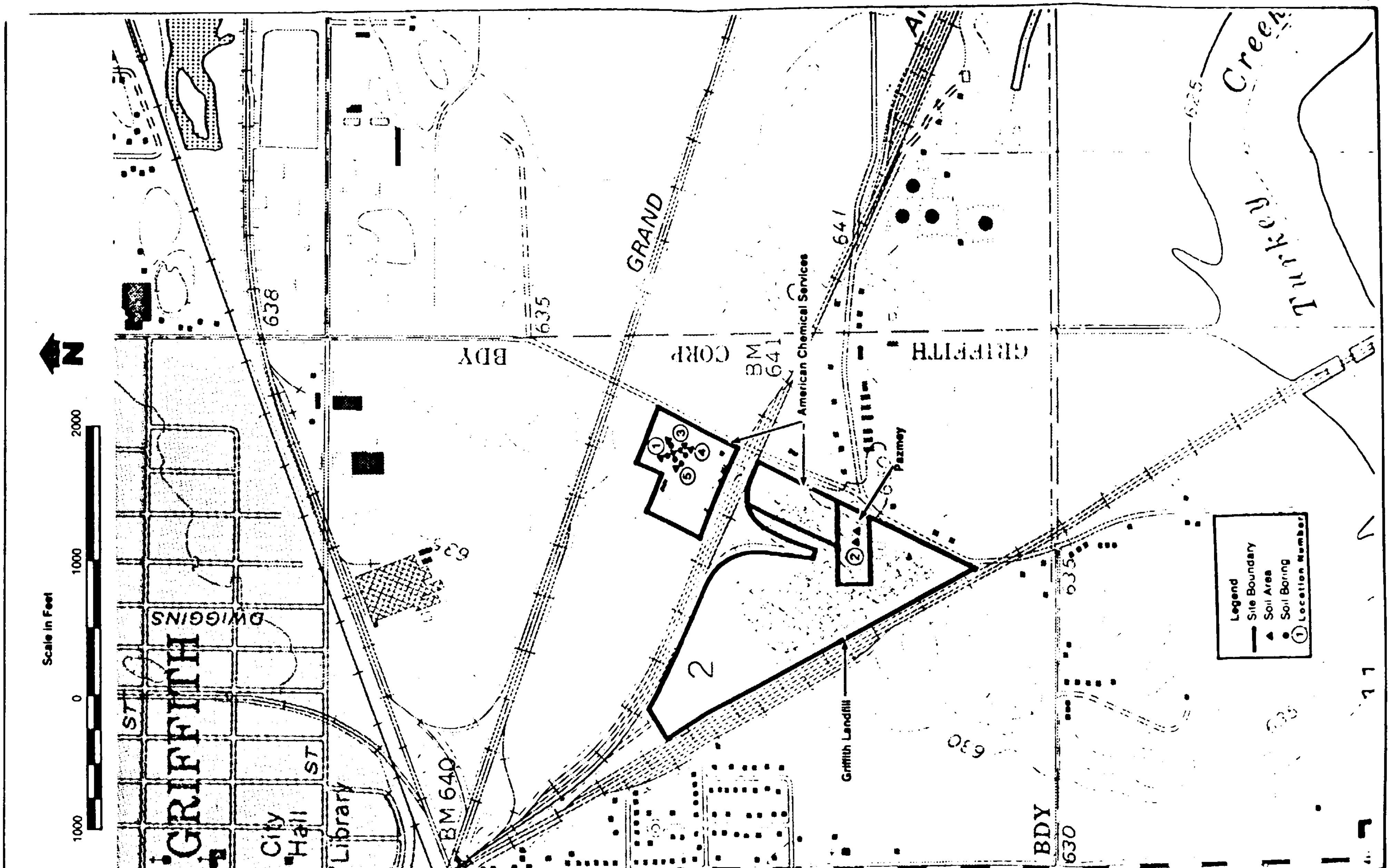


FIGURE 2-3 SOIL AREA AND SOIL BORING LOCATIONS

A fourth soil unit consisting of thick, stiff clay is reported in the area, but borings indicate it is absent on site. The deeper sand and gravel unit is the major water supply aquifer in the area. The depth to bedrock, which consists of interbedded shales and dolomites, is about 130 feet.

Installation of groundwater monitoring wells will provide the data needed to determine the vertical and horizontal directions of groundwater flow and the horizontal and vertical extent of contamination. Also, they will provide better stratigraphic and geotechnical information concerning sediments under the site. Because groundwater is the major contamination concern, 39 stainless steel monitoring wells will be installed as itemized below.

- During Phase I, six well clusters consisting of three wells each will be evenly spaced around the entire site. Each cluster will have a well screened at the water table, another screened at the base of the upper aquifer, and a third well screened in the lower water supply aquifer. Estimated total well footage is 540 feet.

- During Phase II, four well clusters consisting of two wells each will be spaced around the perimeter of the ACS property. One well will be screened at the water table, and the other screened at the base of the upper sand unit. One cluster will utilize (if possible) an existing well (Test Well #1) screened at the water table, and only a well screened at the base of the upper aquifer will be installed. The number and location of the wells will be modified based on the results of Phase I. Estimated total well footage is 120 feet.

- During Phase II, eight single wells, screened at the water table, will be installed in major waste disposal or storage areas. Estimated total well footage is 80 feet.

- During Phase II, six single wells, screened the entire length of the upper sand unit, will be located approximately 1000 feet away from the site. The number and location of these wells will be modified based on the results of Phase I. Total estimated well footage is 120 feet.

The three-well clusters will provide vertical groundwater flow data within the upper aquifer and between the upper and lower aquifer, as well as potentiometric surface data. These clusters as well as the two-well nests will also provide detailed information on the presence, if any, of lighter-than-water and heavier-than-water organic contaminants and their distribution vertically within the upper aquifer. Single wells screened throughout the entire length of the upper aquifer will also provide data of vertical distribution of organics and will aid in defining the extent of contamination. Single wells screened at the water table, along with all other wells in the upper aquifer, will provide the configuration of the water table and direction of groundwater flow. All wells will be grouted to prevent cross-contamination between aquifer and will be installed in compliance with all Indiana regulations.

One round of groundwater samples will be collected from all monitoring wells. Based on the analytical results, a maximum of one-half of the wells will be resampled. Filtered aliquots for metals analysis will be collected at all sampling locations. Unfiltered aliquots will be taken from twenty-five percent of the wells and determination of total metals and total suspended solids will be performed on these samples. The approximate locations of the wells are presented in Figure 2-4.

2.6 SURFACE WATER AND SEDIMENT SAMPLES (PHASE I)

Surface water drainage from the site may contain hazardous contaminants. In addition, contaminated groundwater could be discharging to nearby surface water bodies -- the marsh west of the ACS property and the excavated area at the toe of the working face in the Griffith Landfill. Water that collects in this low area is periodically pumped into a municipal sanitary sewer. Contaminants could also be accumulating on or migrating with sediments that are eroded off the site. Samples of surface water and sediment will be collected and analyzed to assess these possibilities. The approximate locations of these eleven pairs of surface water and sediment samples are shown in Figure 2-5. Sampling locations will include Treatment Pond 2 (Location 1), the ACS Retention Pond (Location 2), a drainage ditch at the southwest corner of the ACS plant (Location 3), the marsh (Location 4), ponded water near the Off-Site Drum Containment Area (Location 5), the Griffith Landfill excavation (Location 6), three sites along a drainage ditch (including a small pond north of the railroad track) connecting the marsh to Turkey Creek (Location 7), a drainage ditch that is parallel to Colfax Avenue south of the intersection of Colfax Avenue and Reder Road (Location 8) and drainage ditch 1800 feet east of the ACS site (Location 9).

2.7 PRIVATE WATER WELLS SAMPLING (PHASES I AND II)

A survey as described in Task 2 will be performed to identify sources of drinking water and groundwater utilization within one mile of the site. Using the data collected during this survey and the information generated concerning local groundwater flow patterns obtained from the newly installed monitoring wells, 25 private wells within one mile of the site will be selected for sampling and chemical analysis. Approximately 12 wells will be sampled during Phase I and the remaining 13 wells will be sampled during Phase II. To the extent possible, these wells will be representative of upgradient and downgradient positions, have an even geographic distribution, and include users of the upper and lower aquifers. Existing data, suggests that the main areas of groundwater use for drinking water are

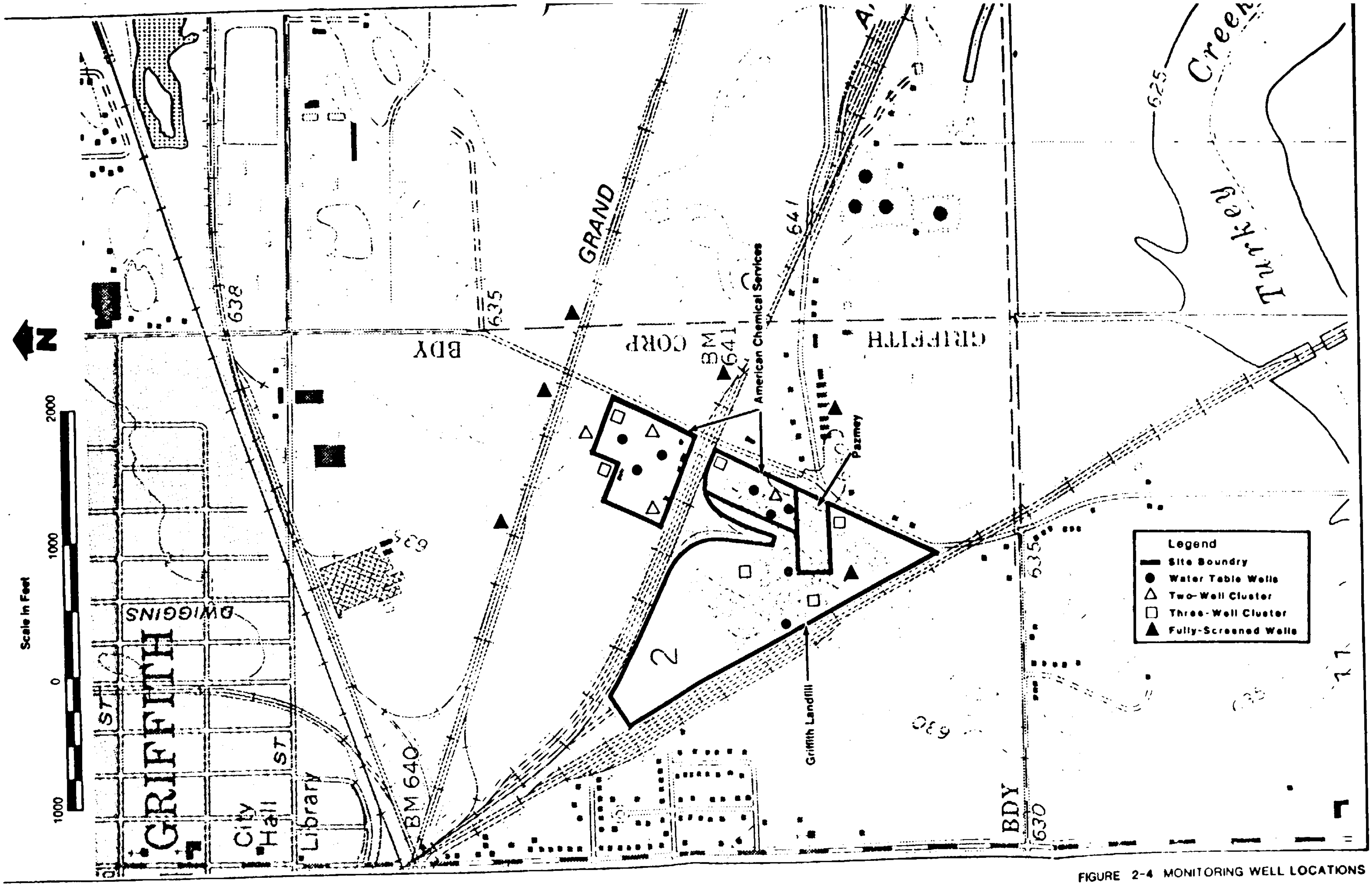


FIGURE 2-4 MONITORING WELL LOCATIONS

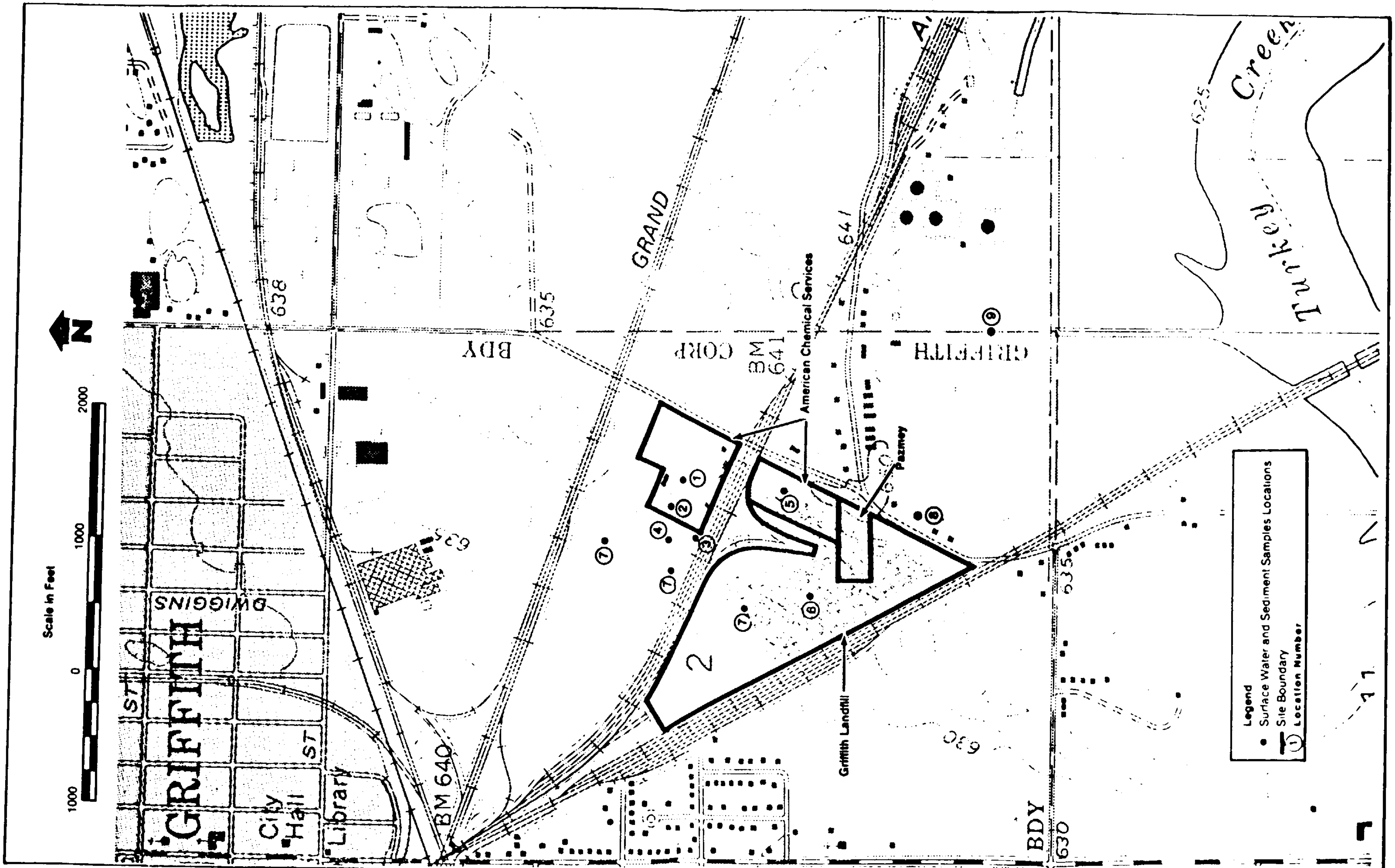


FIGURE 2-5 SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

to the south and east of the ACS site. Information covering well construction (depth, screened interval, materials, etc.) will be obtained, if possible, for each residential well that is sampled.

2.8 DOCUMENTING SAMPLE LOCATIONS

The physical locations of all monitoring wells, borings and on-site (or immediately adjacent off site) sampling sites will be documented photographically and determined by taping and leveling surveys. Taping surveys will use existing buildings, light poles and similar fixed objects shown on the existing site map as reference points. At least three reference points will be used to locate each sampling site. The leveling survey will be tied to mean sea level datum, which may require an off-site traverse to establish an on-site benchmark. Surface water, sediment and soil area sampling locations will be established and surveyed in advance of sample collection. Soil boring, soil trench and monitoring well sites will be surveyed during or after the work is performed. Stakes will be used at sampling locations lacking other physical reference points. Horizontal accuracy will be to within 1.0 foot and vertical accuracy will be to within 0.10 foot.

SECTION 3

SAMPLE NUMBERING SYSTEM

All samples for chemical analysis, including duplicates and blanks, will be given a unique sample number. A listing of sample numbers, cross-referenced to chain-of-custody and shipment documents, will be maintained in the sample handling logbook.

3.1 GENERAL SAMPLE NUMBERING SYSTEM

Two identification numbers will be used for each sample. One will be the serial identification number on the tag attached to the sample shipped to the laboratories; the other will be used for in-house identification of the sample. Under the CLP, the laboratories use the traffic report number to report the results of the analysis. EPA sample tag numbers and/or SAS traffic forms will be used for all samples. The in-house number will be used to incorporate field data into an alphanumeric code. The in-house system is discussed later in this section.

The serial identification number is described as follows:

87 - designates fiscal year
October 1 through September 30)

R - indicates samples sent by Roy F. Weston, Inc.

A - designates project manager
(as assigned, A through Z)

01 - designates survey number
(as assigned, 01 through 99 for each project manager A through Z)

s - indicates sample type
(S = sample, D = duplicate, R = blank)

01 - designates sample number within a given survey
(as assigned, 01 through 99 for each survey 01 through 99)

Upon requesting codes from the documentation coordinator, each project manager will be assigned an alphabetic character A through Z which will be used in all his/her sample codes regardless of the specific site. Survey and sample numbers are site-specific and are allocated in blocks for each sampling trip. Individual sample codes are to be assigned to specific samples by the project manager or sample team leader. A record should be kept of these numbers along with other tracking information for each sample.

3.2 IN-HOUSE SAMPLE NUMBERING SYSTEM

An in-house sample numbering system will be used to identify each sample taken during the sampling program. This numbering system will provide a tracking procedure to allow retrieval of information about a particular sample and will assure that each sample is uniquely numbered. A listing of the sample identification numbers will be maintained by the Sampling Team Leader. Each in-house sample number will be composed of three components, which are described below.

Project Identification

A two-letter designation will be used to identify the site where the sample is collected. For this project, it will be AC, which stands for American Chemical.

Sample Type

Each sample type collected during the sampling program will be identified by a two-digit alpha code. A list of two-letter codes for sample types is presented in Table 3-1.

Sample Location

A two-digit numbering system will be used to indicate the sampling location. The identification system will require that all sampling locations be given a separate number. The field ties to these sampling locations, as well as all other pertinent data, will be kept in the field sampling notebook by the Sampling Team Leader. Location numbers for each sample type are presented in Table 3-1.

Sample Number

Sample number — a two-digit number indicating the first, second, third, etc., sample collected at a given location; or a two-letter code indicating a duplicate (DP) or blank (BK).

In-House Sample Numbering System Example

An example of a sample number is:

- AC-GW30-02

  American Chemical site — groundwater sample from location 30, second sample.

Some examples of the In-House sampling number system are as follows:

- AC-WP04-01: American Chemical Service, waste pit sample, location 04, first sample.

- AC-SA22-DP: American Chemical Service, soil area sample, location 22, duplicate.

- AC-GW55-BK: American Chemical Service, groundwater sample, location 55, blank (taken prior to collecting investigative sample at this location).

Duplicates and blanks must be taken at different locations during each sampling round.

All other pertinent data relating to the sampling event will be included in the sampling notebook.

TABLE 3-1

SAMPLE TYPE CODE NUMBERS

Type	Code
Waste and Natural Soil-Pit	WP, NP
Waste and Natural Soil-Boring	WB, NB
Soil Areas	SA
Soil Borings	SB
Groundwater	GW
Surface Water and Sediment	SW, SD
Private Wells	PW

Note: Soil samples collected during installation of the monitoring wells, which may be tested for geotechnical properties, will have a two-letter code of SL and the appropriate two-digit location number.

SECTION 4

SAMPLE LOCATIONS

4.1 WASTE AND NATURAL SOIL SAMPLES FROM TEST PITS (PHASE I)

Six test pits will be excavated in three areas of known waste burial (the Still Bottoms Pond, Treatment Pond 1, and the On-Site Drum Containment Area) to characterize the nature and concentration waste present and to estimate the volume contained in each area.

Excavation of the test pits will be done with a backhoe and will proceed by layers. That is, the pit will be deepened until different materials are encountered; then the pit will be enlarged areally by careful scraping of the remaining material in that layer. This will allow "clean" surficial materials to be segregated from "dirty" wastes and drums and to be stockpiled. It will also allow the test pit to be backfilled to essentially original conditions.

Because these areas are known to contain buried drums, extreme care will be taken during excavation of the test pit. A magnetometer survey will be conducted prior to the excavation in order to determine the extent of the drum burial areas. In addition to using an experienced backhoe operator, ambient and in-trench air conditions will be monitored for organic vapors, hydrogen sulfide, hydrogen cyanide excavations (disturbed soil structures) or waste burial (discolored soil, non-soil solids, etc.) will be noted, and the entire side wall areas of the pits will be photographed.

Where evidence of waste burial is found, up to three waste samples will be collected in each pit. A 4-inch diameter bucket auger, angled into the sidewall from the opposite side of the pit, will be used to obtain the samples. The material retrieved by the auger will be emptied onto a sheet of Teflon for closer examination and then placed in sample containers using stainless steel spatulas. All sampling equipment will be decontaminated in accordance with the standard protocol presented in Table 4-1 prior to each use. If possible, the pit will be excavated through the waste and just into the underlying natural soils. When natural soils are encountered, the 4-inch bucket auger will be used to obtain a sample of this material from a depth of at least one foot below the bottom of the waste. If a liner is encountered, excavation will cease. The liner shall not be penetrated.

The sampling team for this sampling task (4.1) will consist of two people using level C protection with a contingency to upgraded level B if necessary. Downgrading to level D will be kept as an option if environmental monitoring indicates it is safe. Authorization must come from SSO.

TABLE 4-1

STANDARD DECONTAMINATION PROTOCOL FOR SAMPLING EQUIPMENT

STEP 1 -- Scrub equipment throughly with soft-bristle brushes in a low-sudsing detergent solution.

STEP 2 -- Rinse equipment with tap water by submerging and/or spraying.

STEP 3 -- Rinse equipment with acetone or methanol by spraying until dripping; retain drippings.

STEP 4 -- Rinse equipment with distilled water by spraying until dripping.

STEP 5 -- Place equipment on plastic or aluminum foil and allow to air-dry for five to ten minutes.

STEP 6 -- Wrap equipment in plastic or aluminum foil for handling and/or storage until next use.

Notes: In addition to the standard protocol, pumps and discharge lines will be decontaminated by pumping the detergent solution, tap-water rinse through the equipment.

4.2 WASTE AND NATURAL SOIL SAMPLES FROM BORINGS (PHASE I)

Test borings will be performed at eight on-site locations in two potential source areas (the Off-Site Drum Containment Area and the Kapica Dump Site) to characterize the nature and volume of wastes present. A magnetometer survey will be conducted prior to drilling in order to identify the extent of the drum burial in the off-site drum containment area. If the magnetometer survey or attempted boring indicates that test borings will not be possible, it will be necessary to excavate test pits as described in section 4.1 above. Each boring will be sampled continuously from the ground surface until natural soil is encountered. Samples will be collected using a 3-inch diameter split-spoon device that will be driven into the ground in consecutive 18-inch intervals. The over-sized split-spoon is needed to provide enough sample for standard CLP analyses, especially when duplicates are collected.

The boring will be advanced using hollow stem augers or other methods approved by the geologist that do not use drilling fluids. Because drums are known to be buried in one of these areas, the boring locations will be selected using geophysical survey results and the borings will be advanced with extreme care. The levels of volatile organics, hydrogen cyanide, and explosive gases in the borehole will be measured after every sample is collected.

Upon recovery from the borehole, the sampler will be placed on a clean Teflon sheet and opened. As the spoon is opened, the soil/waste material will be qualitatively screened with OVA and HNu instruments and described by a qualified geologist or geotechnical engineer. The instrument readings and soil/waste description will be entered in the sampling logbook. The soil/waste material will then be divided into three six-inch samples and placed in separate sample containers using stainless steel spatulas. If less than 18 inches of soil is recovered by the split-spoon, the geologist or geotechnical engineer will use his judgment to assign depth intervals to the recovered material.

Five six-inch samples will be sent to the laboratory from each boring in the Off-Site Drum Containment Area and three six-inch samples will be sent from borings at the Kapica Dump Site. The samples to be analyzed are those having depths of 0, 1, 2, 4 and 8 feet at the top of the sample increment as appropriate. The split spoons, Teflon sheet and spatulas will be decontaminated in accordance with the standard protocol presented in Table 4-1 prior to each use. The drilling rig and all related equipment and tools used at one boring will be steam-cleaned prior to re-use.

The sampling team for this task (4.2) will consist of two people and will be in level C with a contingency of level B. Downgrading to level D will be kept as an option if environmental monitoring indicates that it is safe. Authorization for downgrading must come from the SSO.

4.3 SOIL AREA SAMPLES (PHASE I)

Samples of surficial soil material will be collected from six on-site areas in the old Drum Storage Area and two off-site areas in the former Kapica Drum property. At four of the six on-site areas, soil material will be collected at five discrete sites and composited to form two samples for that area (one composite sample for each depth interval). The soil will be collected from depths of 6 to 12 inches and 18 to 24 inches using a 4-inch diameter bucket. When the auger is filled with a sample material from one of the depth intervals, it will be brought to a central location within the area where its contents will be emptied onto a sheet of Teflon. The soil on the Teflon sheet will be covered with plastic until all five sites have been sampled at that depth interval. The composite sample will be placed in the sample bottles after being thoroughly mixed with stainless steel spatulas. The auger will be decontaminated in accordance with the standard protocol presented in Table 4-1 prior to each use, and the Teflon sheet and spatulas will be decontaminated between each area.

Grab samples will be collected at two on-site specific areas: near the fume incinerator and at the site of a spill/fire. The soil will be collected from depths of 6 to 12 inches and 18 to 24 inches at both sites using a 4-inch diameter bucket. When the auger is filled with material from one of the depth intervals, its contents will be emptied onto a sheet of Teflon. The grab sample will be placed in a sample bottle. All equipment will be decontaminated prior to each use.

Within each of the two off-site area, soil material will be collected from two depth intervals at five sites to form two composites for that area. First, a 4-inch bucket auger will be used to collect soil material to a depth of 6 to 12 inches at each of the three sites. These materials will be mixed on a Teflon sheet as described above and placed in sample containers. After decontaminating the Teflon sheet and spatulas, the auger (decontaminated prior to each use) will be used to collect soil material to a depth of 12 to 18 inches at the same three sites. These materials will be mixed and placed in sample containers as described.

For each of the sixteen samples, the soil material collected at each depth interval will be qualitively screened with an OVA and HNu instruments. The instrument readings and soil material description will be entered into the sampling logbook.

The sampling team for this task (4.3) will consist of two people and will be in level C with a contingency of level B. Downgrading to level D will be kept on as an option if environmental monitoring indicate that it is safe. Authorization to downgrade must come from the SSO.

4.4 SOIL BORING SAMPLES (PHASE I)

Soil borings will be performed at six on-site locations in the old Drum Storage Area. Each boring will be sampled continuously from the ground surface to the water table. Samples will be collected using a 3-inch diameter split-spoon device that will be driven into the ground in consecutive 18-inch intervals. The over-sized split-spoon is needed to provide enough sample for standard CLP analyses, especially when duplicates are collected.

Upon recovery from the borehole, the sampler will be placed on a clean Teflon sheet and opened. As the spoon is opened, the soil material will be qualitatively screened with OVA and HNu instruments and described by a qualified geologist or geotechnical engineer. The instrument readings and soil description will be entered in the sampling logbook. The soil material will then be divided into three six-inch samples and placed in separate sample containers using stainless steel spatulas. If less than 18-inches of soil is recovered by the split-spoon, the geologist or geotechnical engineer will use his judgment to assign depth intervals to the recovered material. Three six-inch samples will be sent to the laboratory for each boring location. The samples to be analyzed are those having depths of 1, 2, and 4 feet at the top of the sample increment.

The boring will be advanced using hollow stem augers or other methods approved by the geologist that do not use drilling fluids. The split spoons, Teflon sheet and spatulas, will be decontaminated in accordance with the standard protocol presented in Table 4-1 prior to each use. The drilling rig and all related equipment and tools used at one boring will be steam-cleaned prior to re-use.

The sampling team for this task (4.4) will consist of two people and will be in level C with a contingency of level B. Downgrading to level D will be kept on as an option if environmental monitoring indicate that it is safe. Authorization to downgrade must come from the SSO.

4.5 MONITORING WELL INSTALLATION (PHASE I AND PHASE II)

A total of 39 monitoring wells will be installed at 24 separate locations. Six locations will have well-clusters consisting of three wells, another four locations will have well-clusters consisting of two wells, eight locations will have one water-table well each and six locations will have one well screened the full length of the upper aquifer. The three well nests consist of a well in the water supply aquifer at a depth of about 50 feet, a well at the base of the upper aquifer at a depth of about 20 feet, and a well at the water table at a depth of about 20 feet. The two-well cluster consists of wells at about 20 feet and 10 feet. The single water-table wells will be to a depth of 10 feet, and the single fully penetrating wells will be 20 feet deep. The total drilling footage of this monitoring network is approximately 860 feet.

All personnel involved in monitoring well installation will be in level C with a contingency of level B. Downgrading to level D will be kept on as an option if environmental monitoring indicated it is safe. Authorization to downgrade must come from the SSO.

4.5.1 Three-Well Clusters

Monitoring well installation will begin at the locations have three-well clusters. The deepest well will be installed first so that the shallower soil stratigraphy is mostly defined prior to installation of those wells. The following procedures will be used to install the monitoring wells in the water supply aquifer:

- The working end of the drilling rig and all equipment, tools and materials will be steam cleaned prior to drilling at each location. Provisions will be made to keep the equipment, tools and materials from coming into contact with surficial soils during drilling and well installation.

- The borehole will be advanced using wash rotary drilling methods with 6-inch casing (or hollow steam augers) advanced continuously ahead of the open hole and clean water as the recirculated drilling fluid. When the borehole is about 15 feet into the silty clay unit or at a depth of about 35 feet, 4-inch casing will be telescoped through the 6-inch casing, the existing tank of drilling fluid will be discarded, and a clean tank of drilling fluid will be used to drill the rest of the boring.

- Samples will be collected using standard split-spoon and Shelby tube samplers. Samples will be collected at 2.5-foot intervals to a depth of 35 feet, and at 5-foot intervals to the bottom of the boring. As each sample is recovered, it will be qualitatively screened for organic vapors using OVA and HNu instruments. The instrument readings and soil description will be entered into a sampling logbook. The boring will be logged by a geologist or geotechnical engineer and the samples retained for future reference and possible geotechnical index testing.

- Drilling and sampling will proceed until the borehole has penetrated 5 to 10 feet into the water supply aquifer. Upon completion of drilling, the borehole will be flushed with clean water to remove all suspended solids from the inside of the casing.

- The well will be constructed out of 2-inch diameter, stainless steel with flush-threaded couplings and a five-foot screened interval at the bottom. The screen will be factory mill-slotted or continuously slotted with openings of 0.010 inches.

- If needed, the annular space around the screen will be backfilled with a silt-free flint sand to a height at least two feet above the top of the screen. A two-foot seal of compressed bentonite pellets will be placed above the sand pack, and the remaining annular space will be filled with a cement-bentonite grout placed with a tremie pipe.

- A four-inch diameter galvanized, locking protective casing will be installed at the surface with a concrete anchor and runoff diversion apron. The steel riser will be covered with a loosely fitting, vented steel cap. Locks will be provided. Three vehicle-bumper posts will be installed around the well if it is to be located in a traffic area.

- The well will be developed by surging and pumping until five well volumes have been removed and clear water is obtained during pumping. Upon completion of development, a bail-down recovery test, as described in subsection 4.11, will be performed to document the sensitivity of the well and provide data for calculating the hydraulic conductivity of the screened interval.

The wells screened at the base of the upper aquifer at these locations (three-well clusters) will be installed using procedures similar to those described above except that:

- The hole may be started with 4-inch casing (or 6-inch hollow stem augers), and the drilling fluid need not be changed.

- Samples will be obtained at 5-foot intervals for the entire depth of the boring.

- The depth of the boring, and consequently the depth of the screened interval, will be determined in the field on the basis of soil stratigraphy and possible contaminant concentrations identified in the deep boring.

The shallow wells at these locations will be installed using similar procedures except that:

- The depth of the boring will be determined in the field and will be screened at the water table.

- The screened interval will extend from the bottom of the boring to within three feet of the surface.

- Extra care will be taken to ensure that the annulus of the well is completely sealed against surface runoff.

The details of well construction for three-well clusters are shown schematically in Figure 4.1.

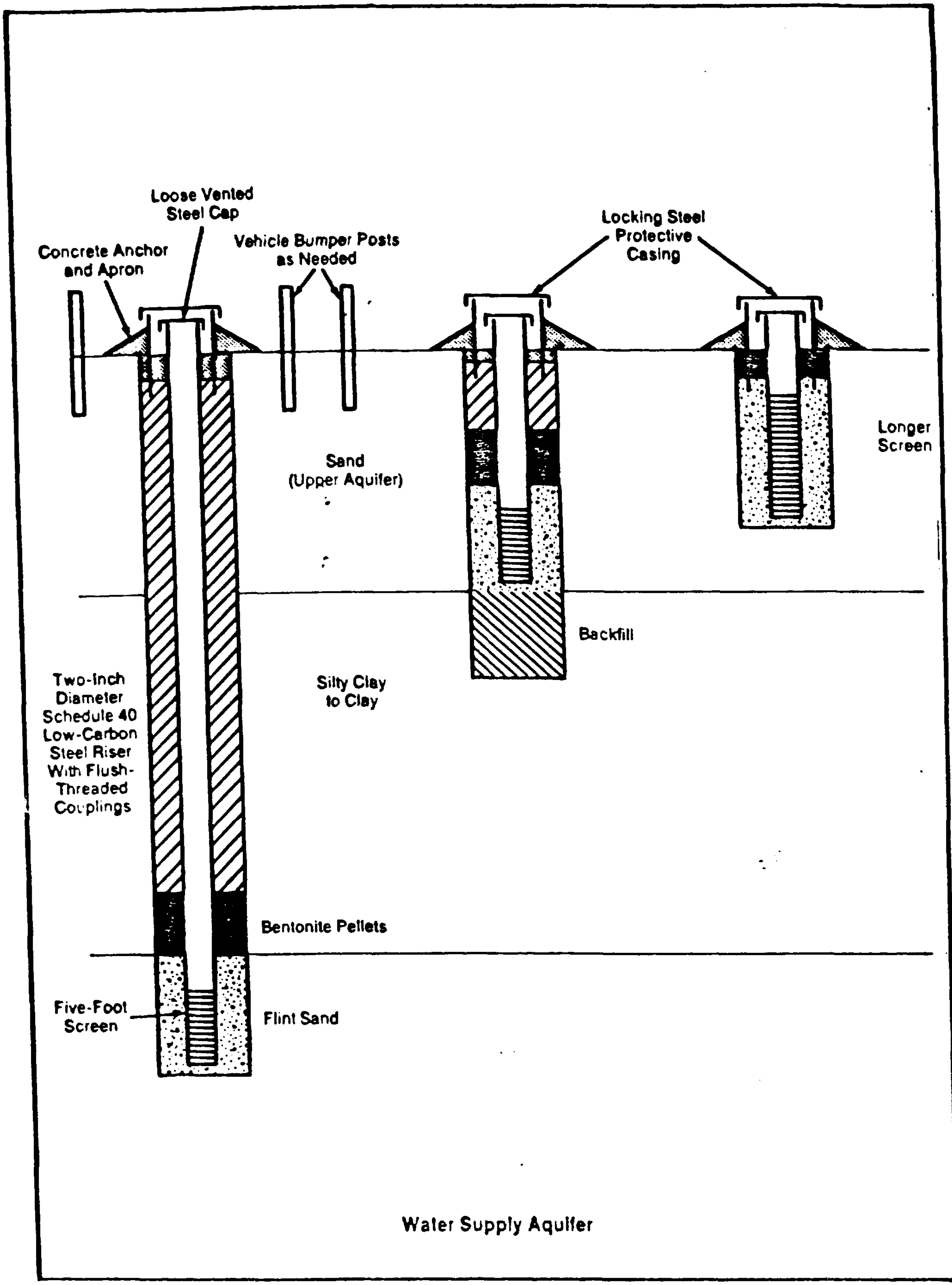


FIGURE 4-1 CONSTRUCTION DETAILS THREE-WELL NEST

4.5.2 Two-Well Clusters

Monitoring wells at locations having two-well clusters will be installed next. The deeper well will be installed first using the following procedures:

- The working end of the drilling rig and all equipment, tools and materials will be steam cleaned prior to drilling at each location. Provisions will be made to keep the equipment, tools and materials from coming into contact with surficial soils during drilling and well installation.

- The borehole will be advanced using wash rotary drilling methods with 4-inch casing (or 6-inch hollow stem augers) advanced continuously ahead of the open hole and clean water as the recirculated drilling fluid.

- Samples will be collected using standard split-spoon and Shelby tube samplers. Samples will be collected at 2.5-foot intervals to the bottom of the boring. As each sample is recovered, it will be qualitatively screened for organic vapors using OVA and HNu instruments. The instrument readings and soil description will be entered into a sampling logbook. The boring will be logged by a geologist or geotechnical engineer and the samples retained for future reference and possibly geotechnical index testing.

- Drilling and sampling will proceed until the borehole has penetrated 3 to 5 feet into the gray silty clay unit. Upon completion of drilling, the borehole will be flushed with clean water to remove all suspended solids from the inside of the casing. The borehole will be backfilled with a mixture of compressed bentonite pellets and sand to the depth selected for the bottom of the screen.

- The well will be constructed out of 2-inch diameter, stainless steel with flush-threaded couplings and a five-foot screened interval at the bottom. The screen will be factory mill-slotted or continuously slotted with openings of 0.010 inches.

- The annular space around the screen will be backfilled with a silt-free flint sand to a height at least two feet above the top of the screen. A two-foot seal of compressed bentonite pellets will be placed above the sand pack, and the remaining annular space will be filled with a cement-bentonite grout placed with a tremie pipe.

- A four-inch diameter galvanized, locking protective casing will be installed at the surface with a concrete anchor and runoff diversion apron. The steel riser will be covered with a loosely fitting, vented steel cap. Locks will be provided. Three vehicle-bumper posts will be installed around the well if it is located in a traffic area.

- The well will be developed by surging and pumping until five well volumes have been removed and clear water is obtained during pumping. Upon completion of development, a bail down recovery test, as described in subsection 4.11, will be performed to document the sensitivity of the well and provide data for calculating the hydraulic conductivity of the screened interval.

The shallow wells at these locations (two-well clusters) will be installed using similar procedures except that:

- Samples will be collected at 5-foot intervals to the bottom of the boring.
- The depth of the boring will be determined in the field and will be screened at the water table.
- The screened interval will extend from the bottom of the boring to within three feet of the surface.
- Extra care will be taken to ensure that the annular of the well is completely sealed against surface runoff.

The details of well construction for two-well nests are shown in Figure 4-2.

4.5.3 Single-Well Installations - Water Table Wells

Monitoring wells at locations having only one well screened at the water table will be installed last using the following procedures:

- The working end of the drilling rig and all equipment, tools and materials will be steam cleaned prior to drilling at each location. Provisions will be made to keep the equipment, tools and materials from coming into contact with surficial soils during drilling and well installation.
- The borehole will be advanced using wash-rotary drilling methods with 4-inch casing (or 6-inch hollow stem augers) advanced continuously ahead of the open hole and clean water as the recirculated drilling fluid.
- Samples will be collected using standard split-spoon and Shelby tube samplers. Samples will be collected at 2.5-foot intervals to the bottom of the boring. As each sample is recovered, it will be qualitatively screened for Organic vapors using OVA and HNu instruments. The instrument

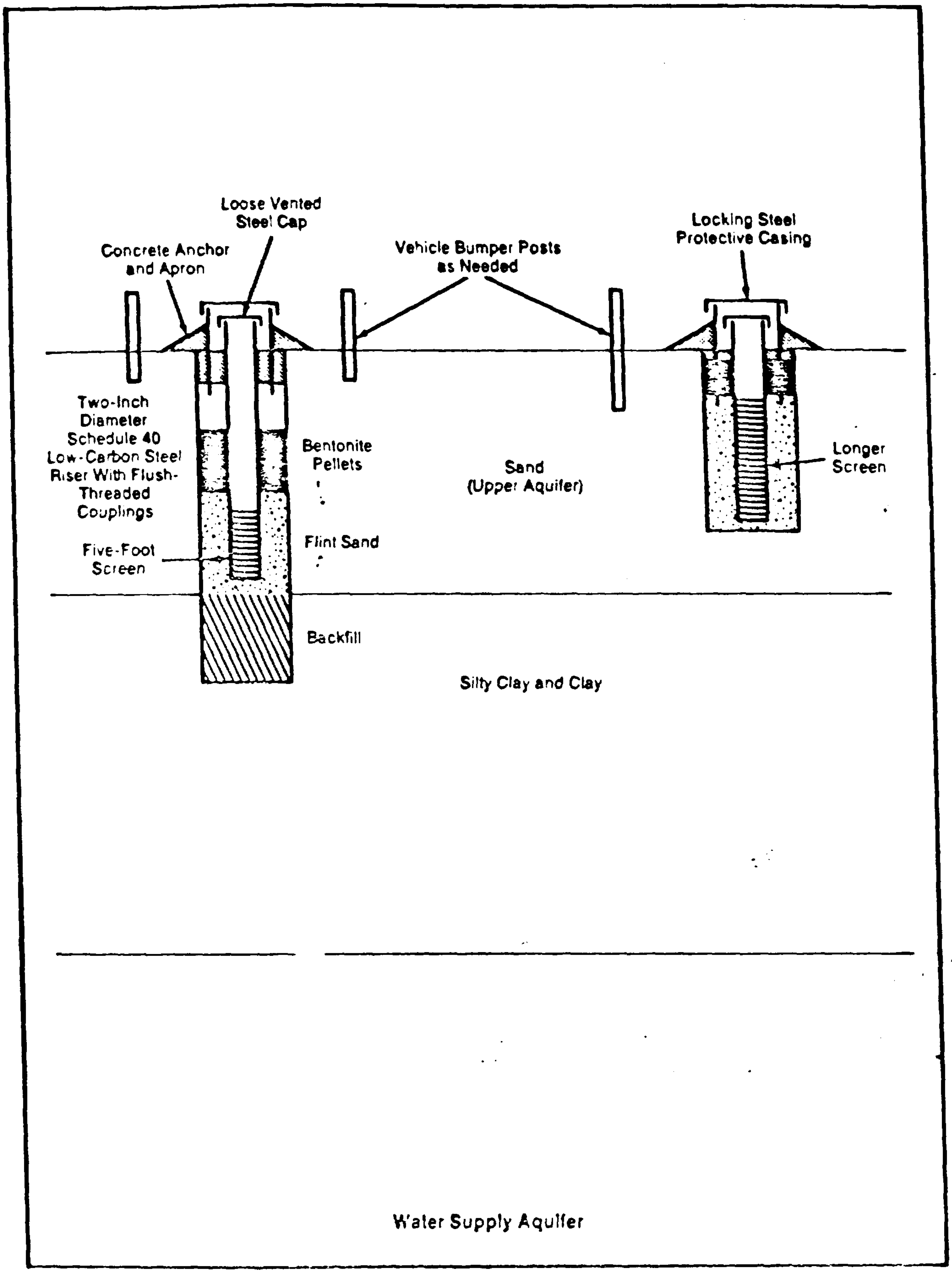


FIGURE 4-2 CONSTRUCTION DETAILS TWO-WELL NEST

readings and soil description will be entered into a sampling logbook. The boring will be logged by a geologist or geotechnical engineer and the samples retained for future reference and possible geotechnical index testing.

- o Drilling and sampling will proceed until the boring is approximately seven feet below the water table. Upon completion of drilling, the borehole will be flushed with clean water to remove all suspended solids from the inside of the casing.

- o The well will be constructed out of 2-inch diameter, low carbon steel with flush-threaded couplings and a five-foot screened interval at the bottom. The screen will be factory mill-slotted or continuously slotted with openings of 0.010 inches.

- o The annular space around the screen will be backfilled with a silt-free flint sand to a height at least two feet above the top of the screen. A two-foot seal of compressed bentonite pellets will be placed above the sand pack.

- o A four-inch diameter, locking protective casing will be installed at the surface with a concrete anchor and runoff diversion apron. The low carbon steel riser will be covered with a loosely fitting, vented steel cap. Locks will be provided. Three vehicle-bumper posts will be installed around the well if it is in a traffic area.

- o The well will be developed by surging and pumping until five well volumes have been removed and clear water is obtained during pumping. Upon completion of development, a bail-down recovery test as described in subsection 4.11 will be performed to document the sensitivity of the well and provide data for calculating the hydraulic conductivity of the screened interval.

The details of well construction for the single-well, water-table installations are shown in Figure 4-3.

4.5.4 <u>Single-Well Installations - Fully Screened Through Upper Aquifer</u>

Monitoring wells at locations having only one well screened through the entire upper aquifer will be installed last using the following procedures:

- o The working end of the drilling rig and all equipment, tools and materials will be steam cleaned prior to drilling at each location. Provisions will be made to keep the

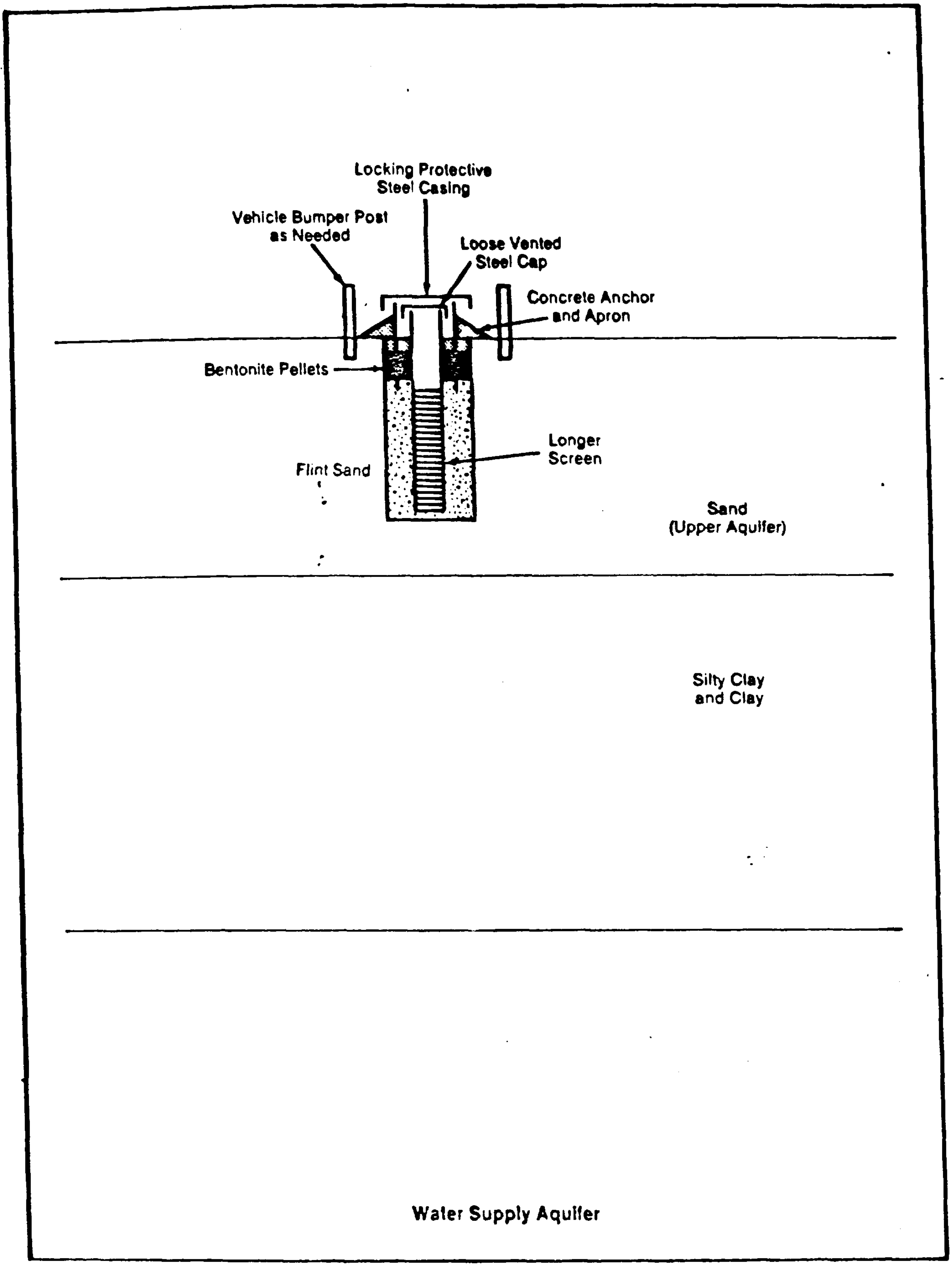


FIGURE 4-3 CONSTRUCTION DETAILS WATER TABLE WELL

equipment, tools and materials from coming into contact with surficial soils during drilling and well installation.

- The borehole will be advanced using wash rotary drilling methods with 4-inch casing (or 6-inch hollow stem augers) advanced continuously ahead of the open hole and clean water as the recirculated drilling fluid.

- Samples will be collected using standard split-spoon and Shelby tube samplers. Samples will be collected at 2.5-foot intervals to the bottom of the boring. As each sample is recovered, it will be qualitatively screened for organic vapors using OVA and HNu instruments. The instrument readings and soil descriptions will be entered into the sampling logbook. The boring will be logged by a geologist or geotechnical engineer and the samples retained for future reference and possible geotechnical index testing.

- DRilling and sampling will proceed until the base of the upper aquifer is encountered. Upon completion of drilling, the borehole will be flushed with clean water to remove all suspended solids from the inside of the casing.

- The well will be constructed out of 2-inch diameter, Schedule carbon steel with flush-threaded couplings and a 15-foot screened interval at the bottom. The screen will be factory mill-slotted or continuously slotted with openings of 0.010 inches.

- The annular space around the screen will be backfilled with a silt-free flint sand to a height at least two feet above the top of the screen. A two-foot seal of compressed bentonite pellets will be placed above the sand pack.

- A four-inch diameter, locking protective casing will be installed at the surface with a concrete anchor and runoff diversion apron. The low carbon steel riser will be covered with a loosely fitting, vented steel cap. Locks will be provided. Three vehicle-bumper posts will be installed around the well if it is in a traffic area.

- The well will be developed by surging and pumping until five well volumes have been removed and clear water is obtained during pumping. Upon completion of development, a bail-down recovery test will be performed to document the sensitivity of the well and provide data for calculating the hydraulic conductivity of the screened interval.

The details of well construction for the single-well, fully penetrating installations are shown in Figure 4-4.

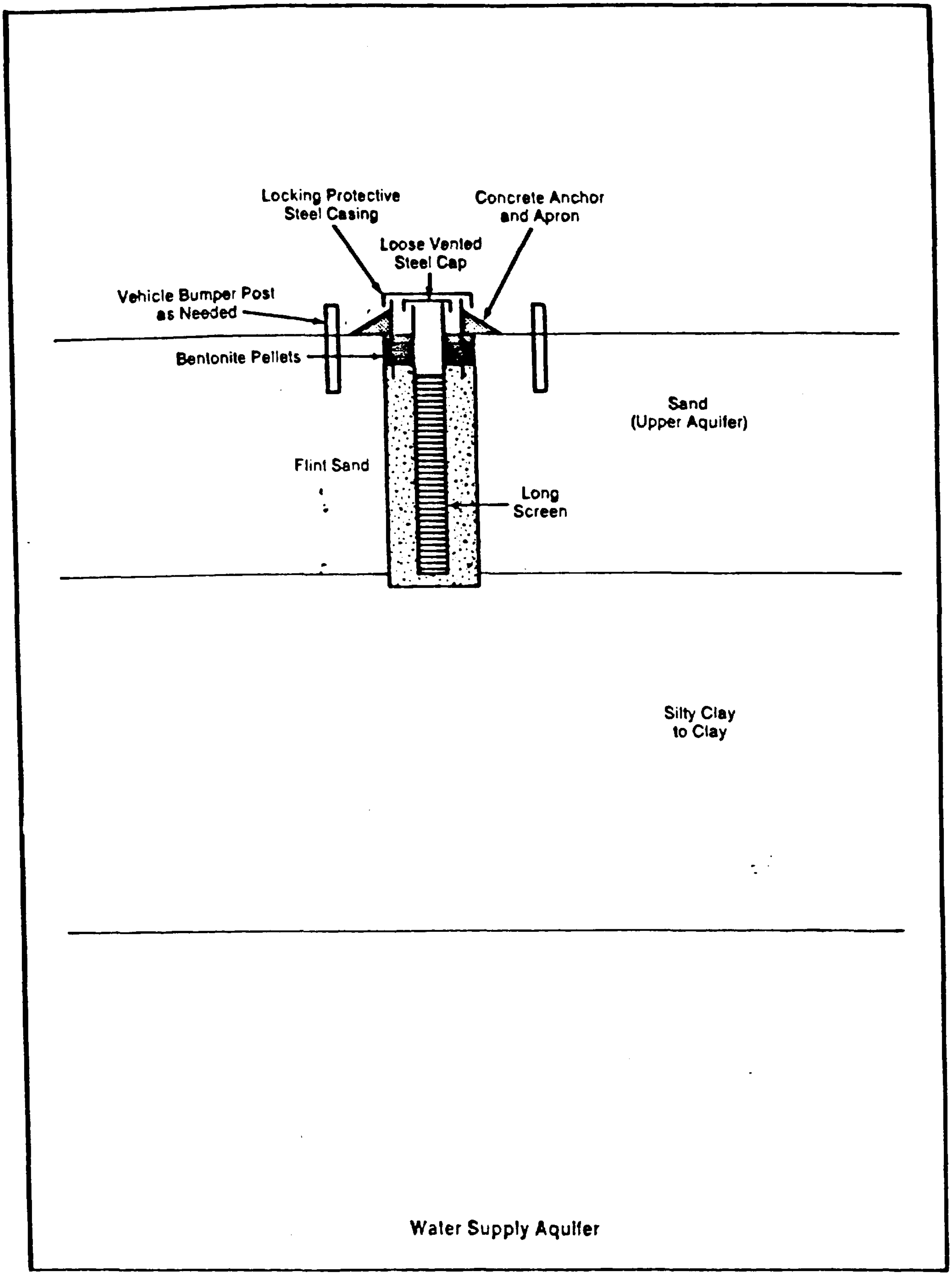


FIGURE 4-4 CONSTRUCTION DETAILS FULLY-SCREENED SINGLE WELL

4.6 GROUNDWATER SAMPLES (PHASE I AND PHASE II)

Groundwater samples will be collected from all 40 monitoring wells. Samples collected using the following procedures:

- The depth to the water level in the well will be measured with an electrical water level sounder or a weighted steel or fiberglass tape. The weight will be designed to create a popping sound on contact with the water surface. The depth to water and the time of measurement will be recorded.

- Based on the water level measurement and the depth of the well, the volume of standing water in the well will be calculated.

- The well will be purged using a positive displacement pump constructed of chemically inert materials which has been decontaminated in accordance with the standard protocol listed in Table 4-1. The standard procedure will be to pump until at least three well volumes have been removed.

- Beginning with the fourth volume, periodic measurements of pH, specific conductance and temperature will be made using the procedures contained in Appendix A.

- Purging may cease when measurements for all three parameters have stabilized ($\pm$0.25 pH units, $\pm$50 umhos/cm, and $\pm 0.5^{\circ}$C) for three consecutive readings or after five well volumes have been removed.

- If the well pumps dry before three volumes have been removed, the well will be allowed to recharge for 15 minutes and then pumped dry again.

- The sample will be obtained with a stainless steel or Teflon bailer which has been decontaminated in accordance with the standard protocol listed in Table 4-1. The bailer will be raised and lowered in the well using a new length of nylon cord at each location.

Samples collected from fully-screened wells will be obtained using the following procedures:

- The depth to the water level in the wells will be measured using an electrical water level sounder or weighted steel or fiberglass tape. The weight will be designed to make a popping sound on contact with the water surface. The depth to water and the time of measurement will be recorded.

- Based on the water level measurement and the depth of the well, the volume of standing water in the well will be calculated.

- Prior to purging the wells, a specific conductance probe will be very slowly lowered down the well so as not to agitate the water. Any increase in specific conductances with depth will be related to contamination.

- The wells will be purged and sampled at specific depth intervals (the upper and lower zone of the well screen or in zones in which high specific conductance readings were encountered) using an inflatable multiple packer pump unit. This is being done in order to retrieve water from a particular zone within the screened section which may be contaminated with heavier-than-water organic contaminants (sinkers) or lighter-than-water organic contaminants (floaters).

- The packer/pump unit will be constructed out of chemically inert materials and decontaminated in accordance with the standard protocol listed in Table 4-1. The pump will be a positive displacement type that should not cause loss of volatile components during sampling.

- The standard procedure will be to purge at least three well volumes beginning with the fourth volumes, periodic measurements of pH, specific conductance, and temperature will be made using the procedures contained in Appendix A.

- Purging may cease when measurements for all three parameters have stabilized (±0.25 pH, ±50 umhos/cm, and ±0.5 1/4C) for three consecutive readings or after five well volumes have been removed.

- If the packer-isolated interval pumps dry before three volumes of water have been removed, the interval will be allowed to recharge for 15 minutes and then pumped dry again.

- All samples will then be collected from the pump discharge line.

Unfiltered samples for metals will be collected at all locations. Filtered samples for metals will be collected at about 25 percent of the locations selected at random during sampling.

The sampling team for this task (4.6) will consist of two people and will be in level C with a contingency of level B. Downgrading to level D will be kept on as an option if environmental monitoring indicates that it is safe. Authorization to downgrade must come from the SSO.

4.7 SURFACE WATER SAMPLES (PHASE I)

Surface water samples will be collected from 11 locations including both on-site and off-site. Six of these nine locations have "flowing water" conditions while the other five have "standing water" conditions. These locations are as follows. See Figure 2-5.

- Three locations in a north-south drainage ditch along the west side of the marsh and one location at the southwest corner of the ACS plant area.
- Treatment Pond 2 (Location 1).
- ACS stormwater retention pond (Location 2).
- Ponded water near the Off-Site Drum Containment Area (location 5).
- Griffith Landfill excavation (sump area) (location 6).
- The marsh (Location 4).
- Off-site drainage ditch that is parallel to Colfax Avenue just south of the intersection of Colfax Avenue and Reder Road (Location 8).
- Off-site drainage ditch 1800 feet east of the ACS site (Location 9).
- Runoff from a drainage ditch located at the southwest corner of the ACS plant (Location 3).
- Three sites along a drainage ditch (including a small pond north of the railroad track) connecting the marsh to Turkey Creek (Location 7).

Samples collected in "flowing water" situations will be collected at mid-stream, (i.e., the fastest flowing portion of the water) just below the water surface. Flow rates will be evaluated by measuring non-sectional area with a staff gauge and tape, and by averaging five measurements of flow velocity determined using a wooden puck. Samples collected in "standing water" situations will be collected at a convenient location as far from the bank of the water body as possible. In both situations single-use intermediate collection bottles, obtained from a Bottle Repository, will be used to acquire the sample aliquots. For field measurements of pH, specific conductance and temperature will be measured and recorded using the procedures contained in Appendix A.

The sampling team for this task (4.7) will consist of two people and will be in level C with a contingency of level B. Downgrading to level D will be kept on as an option if environmental monitoring indicates that it is safe. Authorization to downgrade must come from the SSO.

4.8 SEDIMENT SAMPLES (PHASE I)

Sediment samples will be collected at 11 locations, which will coincide with location of the 11 surface water sampling. See Figure 2-5. Sediment samples will be collected using a 4-inch diameter bucket auger, and will consist of the top 6-inches of solid material at the sampling location. The material collected in the auger will be emptied onto a sheet of Teflon and then transferred into the sample containers using stainless steel spatulas. The sampling equipment, including the spatulas and the Teflon sheet, will be decontaminated in accordance with the standard decontamination protocol presented in Table 4-1 prior to each use.

The sampling team for this task (4.8) will consist of two people and will be in level C with a contingency of level B. Downgrading to level D will be kept on as an option if environmental monitoring indicates that it is safe. Authorization to downgrade must come from the SSO.

4.9 PRIVATE WATER WELL SAMPLES (PHASE I AND PHASE II)

Private water well samples will be collected from 25 homes in the site vicinity. Access to all of these wells will be coordinated by the U.S. EPA, the IDEM, and Lake County Public Health officials. Samples will be collected as close to the well-head as possible, with sample bottles filled directly from a tap/spigot. The well pumps should be operating for at least 10 minutes prior to collection of the sample. Information concerning well construction (depth, screened interval, materials, etc.) will be obtained, if possible, for each residential well that is sampled. Field measurement of pH, specific conductance and temperature will be performed using the procedures contained in Appendix A. The sampling team for this task will consist of two people in level D.

4.10 QUALITATIVE ORGANIC VAPOR SCREENING OF SOIL SAMPLES

The purpose of this activity is to obtain a preliminary indication of the magnitude and distribution of volatile contaminants in the subsurface. (The samples that will be sent in for laboratory analysis have been predetermined by depth so that an attenuation profile can be obtained.) Screening data may also be used to adjust the depths of monitoring wells, particularly in the upper two hydrostratigraphic units. The procedures are as follows:

- o Verify that the OVA and HNu have been calibrated within the past four hours and that the equipment is functioning properly. (For calibration operating and maintenance information refer to "Instruction & Service Manual, MI 2R900AC, Century Systems, Portable Organic Vapor Analyzer, Model OVA-128" and "Instruction Manual for Model PI 101, Photoionization Analyzer, HNu Systems, 1975.)

- o As the split-spoon is opened, pass the air intakes along the sample at a distance of about one-half inch, noting the location and magnitude of any readings.

- o At roughly six-inch intervals, position the intakes close to the sample and then disturb the soil material with a spatula, noting any readings.

- o If methane is believed to be interfering with OVA readings, attempt a second reading using a carbon filter. If hydrogen sulfide is believed to be interfering with HNu readings, attempt to verify its presence with an indicator tube.

- o Record the highest reading on each instrument for each six-inch interval of sample recovered, identifying interferences and basis of measurement.

- o Before the borehole is advanced or the next sample is taken, place the air intakes in the borehole, six inches below the ground surface, noting any readings and interferences as above.

4.11 BAILDOWN TESTING OF WELLS

The basic concept behind these tests is that the rate of rise of the water level in a well after an "instantaneous" withdrawal of a "slug" of water is a function of aquifer hydraulic conductivity. Thus by measuring water levels at various times following withdrawal of the slug, the hydraulic conductivity can be calculated. The basic requirements are being able to quickly withdraw a fairly large slug of water and being able to readily and accurately measure water levels in the well. Analysis of test data should use appropriate computational methods such as that presented by Bouwer, H. and R.C. Rice, 1977, "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells," Water Resources Research, vol. 12, no. 3, pp. 423-428.

Baildown testing of monitoring wells installed at American Chemical Service, Inc. will be performed as follows:

- o Prior to performing the baildown test, an initial measurement of static water level will be made.

- A slug of water will then be withdrawn as rapidly as possible using bailers and/or submersible pumps depending on anticipated conditions. Highly permeable conditions ($K \geq 10^{-3}$ cm/sec) are not anticipated.

- Using a weighted tape or electrical sounding device, water level measurements will be made at the following time intervals (in minutes) — 0, 0.5, 1, 2, 5, 10, 20, 50 and 100.

- The data will be plotted in the field (water level vs. log time) using semi-log paper to determine if the data are sufficient to establish a reasonable straight-line relationship.

- If the data are not sufficient, an additional log cycle of data will be obtained (200, 500 and 1000 minute).

4.12 STORAGE AND DISPOSAL OF DRILLING AND SAMPLING WASTES

The sampling and drilling activities are expected to generate solid and liquid "wastes." The activities, the anticipated type and amount of waste, and the planned handling of the wastes are summarized below.

- Waste pit sampling: solid, approximately one-half cubic yard of spoil per foot of trench — returned to excavation upon completion; liquid — none.

- Waste boring sampling: solid, auger cuttings and excess soil/cuttings collected but not retained in jars — returned to borehole upon completion (bentonite plug placed in borehole near surface); liquid — none.

- Soil area sampling: solid, any excess soil from that collected for the composite — returned to holes created by sample collection; liquid — none.
- Soil boring sampling: solid, auger cuttings and excess soil/cutting collected but not retained in jars — returned to borehole upon completion (bentonite plug placed in borehole near surface); liquid — none.

- Monitoring well installation: solid, approximately one cubic foot of cuttings per 10 lineal feet of borehole (total of about 80 cubic feet) — left at borehole locations if on-site, retained in drums for future disposal, if off-site; liquids, up to 0.8 gallons per lineal foot of well volume of water removed during well development (total not more than 640 gallons), and up to 0.5 gallons per lineal foot of well volume of water removed for baildown testing (total not more than 400 gallons) — retained in drums and bulked with other liquid wastes for future disposal.

- Groundwater sampling: solid — none; liquid, up to 0.8 gallons per lineal foot of well volume of water purged from wells prior to sampling (total not more than 640 gallons) — retain in drums and bulk with other liquid wastes for future disposal.
- Surface water sampling: solid, none, each of 11 locations.
- Sediment sampling: solid, any excess sediment collected in auger but not retained in jars — left at sampling site; liquid — none.
- Private well sampling: no wastes anticipated.

SECTION 5

SAMPLE ANALYSIS AND HANDLING

5.1 TESTING PROGRAM

The testing program for the samples collected during implementation of this plan is summarized in Table 1-2. All water sampled (i.e., surface water, private wells and groundwater) will be tested in the field for pH, specific conductance, and temperature utilizing procedures presented in Appendix A. The water, sediment, waste, and soil samples collected for chemical analysis will be tested for the Routine Analytical Services (RAS) organics package, which uses a GC screening followed by GC/MS analysis for quantification of 133 compounds on the Hazardous Substances List and the RAS inorganics package, which includes 24 metals and cyanide. Based on existing analytical data and site conditions, there will be low, medium and high concentration samples.

The water supply samples will be sent to the Central Regional Laboratory (CRL). High hazard samples will be sent to a Hazardous Substances Laboratory. All other samples for chemical analysis will be sent to assigned Contractor Laboratory Program (CLP) facilities. Special Analytical Services (SAS) will be requested for standard RAS organic and inorganic parameters in extracts from high hazard samples. SAS will also be requested for determination of total suspended solids in unfiltered groundwater samples. Seventy-eight of the soil samples collected during installation of the monitoring wells will be tested to characterize basic, geotechnical index properties. Eighteen samples will be tested for Atterberg Limits, eighteen samples will be tested using sieve and hydrometer analysis, eighteen samples will be tested for cation exchange capacity, eighteen samples will be tested for moisture content and six will be tested to determine coefficient of permeability.

5.2 SAMPLE CONTAINERS AND PRESERVATION

5.2.1 High Hazard Samples

Samples collected for chemical analysis through the CLP that are high hazard, that is those collected from drums, tanks, or spills where they have not been diluted by environmental conditions, will be contained and preserved in accordance with U.S. EPA protocols listed in Table 5-1. These samples are shipped directly to one of the RAS program's Hazardous Substance Laboratories (HSL) for preparation of extracts. The analysis to be performed at the time the high hazard sample preparation is scheduled must be specified to ensure that testing is completed in the same manner as the analytical procedures at the CLP or regional laboratory. All high hazard samples are placed

TABLE 5-1

REQUIRED SAMPLE CONTAINERS AND PRESERVATION
FOR SAMPLES TESTED BY A HAZARDOUS SUBSTANCE LABORATORY

Organics in Water and Liquids (High Concentration)

Testing	Containers	Preservation
All organic analysis	One 8-ounce wide-mouth glass jar with Teflon-lined cap; filled to 3/4 full	None required

Inorganics in Water and Liquids (High Concentration)

Testing	Containers	Preservation
All inorganic analysis	One 8-ounce wide-mouth glass jar; filled to 3/4 full	None required

Organics in Soil and Sediment (High Concentration)

Testing	Containers	Preservation
All organic analysis	One 8-ounce, wide-mouth, glass jar with Teflon-lined cap; filled to 3/4 full	None required

Inorganics in Soil and Sediment (High Concentration)

Testing	Containers	Preservation
All inorganic analysis	One 8-ounce, wide-mouth glass jar; filled to 3/4 full	None required

Note: All high hazard sample bottles must be shipped in paint cans as hazardous to one of the RAS program's Hazardous Substance Laboratory.

into 8-ounce wide-mouth glass jars, sealed into paint cans, and marked as hazardous. No preservatives are required for high hazard samples.

5.2.2 Medium Hazard Samples

Medium hazard samples collected through the CLP will be contained, preserved and shipped as appropriate for the intended testing and in accordance with U.S. EPA protocols listed in Table 5-2. Medium hazard samples are those that have originated from drums or residues, but that have been diluted somewhat by environmental conditions. All medium hazard sample containers will be placed in paint cans and marked as hazardous. The amount of sample required is listed in Table 5-2. In all other respects, medium hazard samples are treated in the same manner as low hazard samples.

5.2.3 Low Hazard Samples

Samples collected for chemical analysis through the CLP will be contained and preserved as appropriate for the intended testing and in accordance with U.S. EPA protocols listed in Table 5-2. Samples collected for chemical analysis by the CRL will be contained and preserved in accordance with the protocols listed in Table 5-3. If necessary, samples will be placed on ice immediately after collection to maintain a temperature of 4°C.

Groundwater samples from all 40 wells collected for RAS inorganics metals analysis will be filtered in the field as soon as possible after collection and prior to the addition of nitric acid preservative. Filtering will be done with a pressure filtration device and 0.45 micron filter paper. The surface water samples (from all 11 locations), all private well samples, and ten groundwater samples collected for metals analysis will not be filtered prior to acid preservation.

5.3 SAMPLE PACKAGING AND SHIPMENT

5.3.1 High Hazard Samples

In preparation for shipment to the analytical laboratories, all samples will be packaged in accordance with the following procedures:

- o Tighten cap securely and seal with tape; mark liquid levels if bottles are partially full.
- o Place all containers into paint cans and fill with vermiculite.

TABLE 5-2

REQUIRED SAMPLE CONTAINERS AND PRESERVATION FOR SAMPLES TESTED BY CLP

Organics in Water and Liquids (Medium Concentration)

Testing	Containers	Preservation
Extractables (acid, base/neutral, pesticides/PCB)	Four 32-ounce, wide-mouth glass jars with Teflon-lined caps; filled to neck	None Required
Volatiles	Two 40-ml VOA vials with Teflon-lined caps; completely filled—no air bubbles	None Required

Inorganics in Water and Liquids (Medium Concentration)

Testing	Containers	Preservation
Metals	One 16-ounce, wide-mouth glass amber bottle; filled to shoulder	1:1 HNO_3 to pH <2
Cyanide	One 16-ounce wide-mouth glass amber bottle; filled to shoulder	6N NaOH to pH >12
Total suspended solids	One 500-ml high density polyethylene bottle; filled to shoulder	None Required
Total dissolved solids	One 500-ml high density polyethylene bottle; filled to shoulder	None Required

TABLE 5-2 (Continued)

REQUIRED SAMPLE CONTAINERS AND PRESERVATION
FOR SAMPLES TESTED BY CLP

Inorganics in Water and Liquids (Medium Concentration) - Continued

Minerals		
Acidity	One 500-ml high density polyethylene bottle; filled to shoulder	Cool 4°C
Alkalinity		Cool 4°C
Chloride		Room temperature
Fluoride		Room temperature
Sulfate		Cool 4°C
Nutrients		
Ammonia	One 1-liter polyethylene bottle; filled to shoulder	1 ml 1:1 H_2SO_4 to pH <2; cool 4°C
COD		
TKN		
NO_3NO_2		
TOC		
Total Phosphorous		

Organics in Soil and Sediment (Medium Concentration)

Testing	Containers	Preservation
Extractables (acid, base/neutral, pesticides/PCB)	One 8-ounce, wide-mouth, glass jar with Teflon-lined lid; filled about 3/4 full	None Required
Volatiles	Two 120-ml glass vials with Teflon-lined lid; filled as completely as possible.	None Required

Inorganics in Soil and Sediment (Medium Concentration)

Testing	Containers	Preservation
Metals and Cyanide	One 8-ounce, wide-mouth glass jar; filled about 3/4 full	None Required

Note: All medium hazard sample bottles must be shipped in paint cans marked as hazardous.

TABLE 5-2 (continued)

REQUIRED SAMPLE CONTAINERS AND PRESERVATION
FOR SAMPLES TESTED BY CLP

Note: (Continued)

Water samples collected for duplicate analysis must be collected at double the volume specified for organics and inorganics. Samples selected for matrix spikes must be collected at triple the volume specified for extractables and volatiles. In addition, one volatile trip blank (distilled-deionized water poured directly into two 40-ml vials) should be supplied per shipment.

Organics in Water and Liquids (Low Concentration)

Testing	Containers	Preservation
Extractables (acid, base/neutral, pesticides/PCB)	Two 1/2-gallon glass amber bottles with Teflon-lined caps; filled to neck	Iced to 4°C
Volatiles	Two 40-ml VOA vials with Teflon-lined caps; completely filled--no air bubbles	Iced to 4°C

Inorganics in Water and Liquids (Low Concentration)

Testing	Containers	Preservation
Metals	One 1-liter high density polyethylene bottle; filled to shoulder	1:1 HNO_3 to pH <2
Cyanide	One 1-liter high density polyethylene bottle; filled to shoulder	6N NaOH to pH >12
Total suspended solids	One 500-ml high density polyethylene bottle; filled to shoulder	None Required

TABLE 5-2 (Continued)

REQUIRED SAMPLE CONTAINERS AND PRESERVATION
FOR SAMPLES TESTED BY CLP

Inorganics in Water and Liquids (Low Concentration) - Continued

Total dissolved solids	One 500-ml high density polyethylene bottle; filled to shoulder	None Required
Minerals		
Acidity	One 500-ml high density poly-ethylene bottle; filled to shoulder	Cool 4°C
Alkalinity		Cool 4°C
Chloride		Room temperature
Fluoride		Room temperature
Sulfate		Cool 4°C
Nutrients		
Ammonia	One 1-liter poly-ethylene bottle; filled to shoulder	1 ml 1:1 H_2SO to pH <2; cool 4°C
COD		
TKN		
NO_3NO_2		
TOC		
Total Phosphorous		

Organics in Soil and Sediment (Low Concentration)

Testing	Containers	Preservation
Extractables (acid, base/neutral, pesticides/PCB)	One 8-ounce, wide-mouth, glass jar with Teflon-lined lid; filled about 3/4 full	Iced to 4°C
Volatiles	One 8-ounce glass vial with Teflon-lined lid; filled as completely as possible.	Iced to 4°C

Inorganics in Soil and Sediment (Low Concentration)

Testing	Containers	Preservation
Metals and Cyanide	One 8-ounce, wide-mouth glass jar; filled about 3/4 full	Iced to 4°C (optional)

TABLE 5-2 (Continued)

REQUIRED SAMPLE CONTAINERS AND PRESERVATION
FOR SAMPLES TESTED BY CLP

Note: Water samples collected for duplicate analysis must be collected at double the volume specified for organics and inorganics. Samples selected for matrix spikes must be collected at triple the volume for extractables and volatiles. In addition, one volatile trip blank (distilled-deionized water poured directly into two 40-ml vials) should be supplied per shipment.

TABLE 5-3

REQUIRED SAMPLE CONTAINERS AND PRESERVATION
FOR SAMPLES TESTED BY CRL

Organics in Water Supply Samples (Low Concentration)

Testing	Containers	Preservation
Acid extractables, base neutral extractables	1/2-gallon glass amber bottles (Teflon-lined caps); filled to neck	Cool, 4°C
Pesticides/ PCB's	1/2-gallon glass amber bottles (Teflon-lined caps); filled to neck	Cool, 4°C
Volatiles	40-ml volatiles organic analysis (VOA) vials; filled completely with no air bubbles	Cool, 4°C

Inorganics in Water Supply Samples (Low Concentrations)

Testing	Containers	Preservation
Metals	One 1-liter high density polyethylene bottles filled to shoulder	5 ml 8N HNO_3 to pH < 2, iced to 4°C optional
Mercury	One 1-liter high density polyethylene bottle filled to shoulder	20 mil of 0.5% HNO_3/ 0.05% $K_2Cr_2O_7$ solution
Cyanide	One 1-liter polyethylene bottle, filled to shoulder	5 ml 6N NaOH to pH > 12, cool, 4°C
Minerals		
Alcalinity	One 500-ml polyethylene bottle, filled to shoulder	Cool, 4°C
Chloride		Room temperature
Fluoride		Room temperature
Sulfate		Room temperature
Hardness		Room temperature

TABLE 5-3 (continued)

REQUIRED SAMPLE CONTAINERS AND PRESERVATION
FOR SAMPLES TESTED BY CRL

Inorganics in Water Supply Samples (Low Concentration)-continued

Testing	Containers	Preservation
Nutrients Ammonia TKN NO_3-NO_2 TOC Total Phosphorus	One 1-liter polyethylene bottle: filled to shoulder	1 ml conc. H_2SO_4 to pH <2 cool, 4°C TKN
Total suspended solids	One 500-ml high density polyethylene bottle; filled to shoulder	None Required
Total dissolved solids	One 500-ml high density polyethylene bottle; filled to shoulder	None Required

Note: Water samples collected for duplicate analysis must be collected at double the volume specified for organics and inorganics. Samples collected for matrix spikes must be collected at triple the volume specified for extractables and volatiles. In addition, the volatile trip blank (distilled-deionized water poured directly into two 40-ml vials) should be supplied per shipment.

- Make sure traffic report labels and custody tags are securely attached to the sample container; place each container in a zip-loc baggie, ensuring that labels can be read.

- Place containers in a cooler lined with two inches of vermiculite or equivalent absorbent material; surround each sample and fill remaining space in cooler with additional packing material.

- Put chain-of-custody forms and traffic reports in a manilla envelope; place envelope in a zip-loc baggie and tape to inside of cooler lid.

- Close cooler and seal shut with strapping tape; if cooler has a drain port, seal it shut with tape; place custody seals across closure at front of cooler.

- Mark cooler with proper labels indicating hazardous substances.

- Affix airbill with shipper's and consignee's addresses to top of cooler; if samples are liquid, place "This End Up" labels appropriately.

- Ship to a Hazardous Substances Laboratory.

High hazard samples will be shipped within 24 hours of collection via Federal Express, Purolator, or Emery for next-day delivery. The Sample Management Office will be notified of each shipment as it is made.

5.3.2 Medium Hazard Samples

Medium hazard samples will be packaged in the same manner as high hazard samples, but are analyzed by the CLP, rather than a Hazardous Substances laboratory. Organics samples will be shipped within 24 hours of collection via Federal Express, Purolator, or Emery for next-day delivery. Inorganics samples will be shipped within 48 hours of collection for two-day delivery. The Sample Management Office will be notified of each shipment as it is made.

5.3.3 Low Hazard Samples

In preparation for shipment to the analytical laboratories, all samples will be packaged in accordance with the following procedures:

- Check to make sure that sample is properly preserved; tighten cap securely and seal with tape; mark liquid levels if bottles are partially full.

- Make sure traffic report labels and custody tags are securely attached to the sample container; place each container in a zip-loc baggie, ensuring that labels can be read.

- Place containers in a cooler lined with two inches of vermiculite or equivalent absorbent material; surround each sample and fill remaining space in cooler with additional packing material.

- Put chain-of-custody forms and traffic reports in a manilla envelope; place envelope in a zip-loc baggie and tape to inside of cooler lid.

- Close cooler and seal shut with strapping tape; if cooler has a drain port, seal it shut with tape; place custody seals across closure at front of cooler.

- Affix airbill with shipper's and consignee's addresses to top of cooler; if samples are liquid, place "This End Up" labels appropriately.

Organics samples will be shipped within 24 hours of collection via Federal Express, Purolator, or Emery for next-day delivery. I-organics samples will be shipped within 48 hours of collection for two-day delivery. The Sample Management Office will be notified of each shipment as it is made.

SECTION 6

SAMPLE DOCUMENTATION AND TRACKING

6.1 FIELD RECORDS

Field observations and other pertinent information pertaining to the collection of samples will be recorded in bound log books using black ink. Assignment of field logbooks will be recorded on a daily basis in the master log book. Notebooks shall be assigned to field personnel. Each notebook will be identified as the Document Control Number. The cover of the notebook contains the following information: organization, book number, project name, start date, and end date.

Standard formats will be developed so that data relating to the collection of each type of sample and to the installation of monitoring wells are consistently recorded. These formats will be converted into rubber stamps to reduce the amount of writing required by the sampling team. The data to be recorded will include date, time, samplers, level of personnel protection being use on-site, location, sample number, custody tag number, weather, instrument readings and visual description of sample, and the signature of the person making the entry, in addition to other data specific to each sample type. The standard formats are presented in Tables 6-1 to 6-9. In addition to written records, photographs will be taken as needed to further clarify sampling activities. The film roll number and number of photographs taken at each sampling location will be noted.

6.2 CHAIN-OF-CUSTODY PROCEDURES

All samples will be collected and handled in accordance with the chain-of-custody procedures below:

- All information required on the custody tag, including the signatures of all sampling team members and a predesignated location description, will be filled out in the field.

- Prior to relinquishing samples for packaging and shipment, one member of the sampling team will transfer all data contained on the custody tags to a chain-of-custody record, which all team members will sign.

- The individual who prepared the chain-of-custody record will relinquish the samples to the sample handling technician, who will prepare all CLP traffic reports and affix appropriate traffic report labels to the sample containers.

TABLE 6-1 STANDARD FORMAT TEST PIT SAMPLE COLLECTION

ACS, INC. LOGGED BY:

TEST PIT SAMPLING

DATE: LOCATION:

SAMPLERS:

WEATHER:

TIME EXCAVATION BEGAN: HRS

TIME EXCAVATION ENDED: HRS

DEPTH OF TEST PIT /AIR MONITORING

0 FT/

2 FT/

4 FT/

6 FT/

8 FT/

10 FT/

12 FT/

14 FT/

16 FT/

18 FT/

20 FT/

[FOR EACH TEST PIT]

FIELD SAMPLE NO.:

LOCATION DESCRIPTION:

DEPTH OF SAMPLE: FEET

SAMPLE DESCRIPTION:

ORGANIC VAPOR SCREENING + SAMPLE

OVA: PPM

HNu: PPM SPAN POT:

CUSTODY TAG NUMBERS (HIGH/MEDIUM)

EXTRACTABLES:

VOLATILES:

INORGANICS:

REMARKS:

[FOR EACH SAMPLE]

TABLE 6-2 STANDARD FORMAT TEST BORING SAMPLE COLLECTION

ACS, INC. LOGGED BY: ______

TEST BORING SAMPLING ______

DATE: ______ LOCATION: ______

SAMPLERS: ______

WEATHER: ______

TIME DRILLING BEGAN: ______ HRS

TIME DRILLING ENDED: ______ HRS

LOCATION DESCRIPTION: ______

HAMMER WEIGHT : 140 LBS - 300 LBS

BLOW COUNTS/RECOVERY

0-1.5 FT ______ / ______

1.5-3.0 FT ______ / ______

3.0-4.5 FT ______ / ______

4.5-6.0 FT ______ / ______

6.0-7.5 FT ______ / ______

7.5-9.0 FT ______ / ______

BLOW COUNTS/RECOVERY

9.0-10.5 ______ / ______

10.5-12.0 ______ / ______

12.0-13.5 ______ / ______

13.5-15.0 ______ / ______

15.0-16.5 ______ / ______

16.5-18.0 ______ / ______

18.0-19.5 ______ / ______

19.5-21.0 ______ / ______

21.0-22.5 ______ / ______

22.5-24.0 ______ / ______

24.0-25.5 ______ / ______

25.5-27.0 ______ / ______

27.0-28.5 ______ / ______

28.5-30.0 ______ / ______

[FOR EACH BORE E]

TABLE 6-2 (continued) STANDARD FORMAT TEST BORING SAMPLE COLLECTION

FIELD SAMPLE NO:

DEPTH INTERVAL:

TIME SAMPLE COLLECTED: HRS

SAMPLE DESCRIPTION:

ORGANIC VAPOR SCREENING - BOREHOLE

OVA: PPM

HNU: PPM SPAN POT:

SAMPLE	OVA (PPM)	HNU (PPM)
TOP (C)		
MIDDLE (B)		
BOTTOM (A)		

CUSTODY TAG NUMBERS:

EXTRACTABLES:

VOLATILES:

INORGANICS:

REMARKS:

[FOR EACH SPLIT SPOON]

6-4

TABLE 6-3 STANDARD FORMAT SOIL AREAS SAMPLE COLLECTION

ACS, INC. LOGGED BY: ______

SOIL AREA SAMPLING

DATE: ______ AREA: ______

FIELD SAMPLE NO.: ______

SAMPLERS: ______

WEATHER: ______

TIME COLLECTION BEGAN: ______ HRS

TIME COLLECTION ENDED: ______ HRS

DEPTH INTERVAL: ______ INCHES

AREA DESCRIPTION: ______

SITE DESCRIPTIONS:

1) ______
2) ______
3) ______
4) ______
5) ______

SOIL DESCRIPTIONS:

1) ______
2) ______
3) ______
4) ______
5) ______

CUSTODY TAG NUMBERS:

EXTRACTABLES: ______
VOLATILES: ______
INORGANICS: ______

REMARKS: ______

TABLE 6-4 STANDARD FORMAT SOIL BORINGS SAMPLE COLLECTION

ACS INC. LOGGED BY:

SOIL BORING SAMPLING

DATE: LOCATION:

SAMPLERS:

WEATHER:

TIME DRILLING BEGAN: HRS

TIME DRILLING ENDED: HRS

LOCATION DESCRIPTION:

HAMMER WEIGHT : 140 LBS - 300 LBS

BLOW COUNTS/RECOVERY

0-1.5 FT /

1.5-3.0 FT /

3.0-4.5 FT /

4.5-6.0 FT /

6.0-7.5 FT /

7.5-9.0 FT /

[FOR EACH BOREHOLE]

FIELD SAMPLE NO:

DEPTH INTERVAL:

TIME SAMPLE COLLECTED: HRS

SAMPLE DESCRIPTION:

ORGANIC VAPOR SCREENING - BOREHOLE

OVA: PPM

HNU: PPM STAN POT:

SAMPLE OVA (PPM) HNU (PPM)

TOP (C)

MIDDLE (B)

BOTTOM (A)

CUSTODY TAG NUMBERS:

EXTRACTABLES:

VOLATILES:

INORGANICS:

REMARKS:

[FOR EACH SPLIT-SPOON]

TABLE 6-5 STANDARD FORMAT MONITORING WELL INSTALLATION

ACS INC. LOGGED BY ______

WELL INSTALLATION ______

LOCATION: ______ UNIT: ______

INSTALLERS: ______

WEATHER: ______

LOCATION DESCRIPTION: ______

TIME DRILLING BEGAN ______ HRS

DATE: ______

TIME DRILLING ENDED ______ HRS

DATE: ______

TIME INSTALLATION BEGAN ______ HRS

DATE: ______

TIME INSTALLATION ENDED ______ HRS

DATE: ______

TIME DEVELOPMENT BEGAN ______ HRS

DATE: ______

TIME DEVELOPMENT ENDED ______ HRS

DATE: ______

FIELD SAMPLE NO.: ______

TIME SAMPLE COLLECTED: ______ HRS

SAMPLE TYPE: SPLIT-SPOON -- SHELBY TUBE

DEPTH INTERVAL: ______

BLOW COUNTS (SPT) / RECOVERY (INCHES)

SAMPLE DESCRIPTION: ______

ORGANIC VAPOR SCREENING -- BOREHOLE

OVA ______ PPM

HNu ______ PPM STAN POT: ______

SAMPLE	OVA (PPM)	HNu (PPM)
TOP (C)		
MIDDLE (B)		
BOTTOM (A)		

CUSTODY TAG NOS: (C) ______

(B) ______ (A) ______

REMARKS: ______

6-7

TABLE 6-5(continued) STANDARD FORMAT MONITORING WELL INSTALLATION

TOTAL DEPTH OF BORING: ________ FEET

CASING FLUSHED CLEAN: YES--NO

WELL CONSTRUCTION:

SCREEN LENGTH: ________ FEET

SLOT TYPE: MILLED -- CONTINUOUS

SLOT SIZE: ________ INCHES

WELL DIAMETER: ________ INCHES

RISER LENGTH: ________ FEET

RISER MATERIAL: ________

COUPLING METHOD: ________

DEPTH TO TIP OF SCREEN: ________ FEET

ANNULUS BACKFILLING (FEET)

CONCRETE: ________ TO ________

C/B GROUT: ________ TO ________

PELLET SEAL: ________ TO ________

FLINT SAND: ________ TO ________

CAVED SOIL: ________ TO ________

FLINT SAND: ________ TO ________

PELLETS & SAND: ________ TO ________

DEPTH OF [illegible] ZONE: ________ FEET

PROTECTIVE CASING

DIAMETER: ________ INCHES

LENGTH: ________ FEET

STICK-UP: ________ FEET

LOCKING: YES--NO

WELL DEVELOPMENT:

INITIAL WATER DEPTH: ________ FEET

VOLUME IN WELL: ________ GALS

VOLUME REMOVED: ________ GALS

SURGE & PUMP CYCLES: 1--2--3--4--15

FINAL DISCHARGE CLEAR: YES--NO

REMARKS: ________

[FOR EACH WELL]

TABLE 6-5 (continued) STANDARD FORMAT MONITORING WELL INSTALLATION

BAIL-DOWN RECOVERY TEST

INITIAL WATER DEPTH ________ FEET

WELL DIAMETER ________ INCHES

WATER VOLUME REMOVED ________ GALS.

DURATION OF BAIL-DOWN ________ MINS.

RECOVERY MEASUREMENTS

TIME (MIN)	DEPTH (FEET)
0	
½	
1	
2	
5	
10	
20	
50	
100	

REMARKS:

TABLE 6-6 STANDARD FORMAT GROUNDWATER SAMPLE COLLECTION

ACS, INC. LOGGED BY: ____

GROUNDWATER SAMPLING ____

DATE: ____ LOCATION: ____

FIELD SAMPLE NO.: ____

SAMPLERS: ____

WEATHER: ____

INITIAL WATER DEPTH: ____ FEET

TOTAL WELL DEPTH: ____ FEET

WATER VOLUME IN WELL: ____ GALS

TIME PURGING BEGAN: ____ HRS

TIME PURGING ENDED: ____ HRS

DID WELL GO DRY: YES -- NO

WATER VOLUME PURGED: ____ GALS

LOCATION DESCRIPTION: ____

TIME COLLECTION BEGAN: ____ HRS

TIME COLLECTION ENDED: ____ HRS

SAMPLE DESCRIPTION: ____

FIELD MEASUREMENTS

pH ____ standard units

SPEC. COND.: ____ umhos/cm

TEMPERATURE: ____ °C

METALS FIELD FILTERED: YES -- NO

CUSTODY TAG NUMBERS:

EXTRACTABLES: ____

VOLATILES: ____

METALS: ____

CYANIDE: ____

REMARKS: ____

[FOR EACH SAMPLE]

TABLE 6-7 STANDARD FORMAT SURFACE WATER SAMPLE COLLECTION

ACS, INC. LOGGED BY: ____

SURFACE WATER SAMPLING ____

DATE: ____ LOCATION: ____

FIELD SAMPLE NO.: ____

SAMPLERS: ____

TIME SINCE LAST RUNOFF: ____ DAYS

WEATHER: ____

TIME COLLECTION BEGAN: ____ HRS

TIME COLLECTION ENDED: ____ HRS

INTERMEDIATE BOTTLE USED: YES - NO

LOCATION DESCRIPTION: ____

SAMPLE DESCRIPTION: ____

FIELD MEASUREMENTS:

pH: ____ standard units

SPEC. COND: ____ umhos/cm

TEMPERATURE: ____ °C

METALS FIELD FILTERED: YES - NO

CUSTODY TAG NUMBERS

EXTRACTABLES: ____

VOLATILES: ____

METALS: ____

CYANIDE: ____

REMARKS: ____

TABLE 6-8 STANDARD FORMAT SEDIMENT SAMPLE COLLECTION

ACS, INC. LOGGED BY: ______

SEDIMENT SAMPLING ______

DATE: ______ LOCATION: ______

FIELD SAMPLE NO.: ______

SAMPLERS: ______

TIME SINCE LAST RUNOFF: ______ DAYS

WEATHER: ______

TIME COLLECTION BEGAN: ______ HRS

TIME COLLECTION ENDED: ______ HRS

LOCATION DESCRIPTION: ______

SAMPLE DESCRIPTION: ______

CUSTODY TAG NUMBERS: ______

EXTRACTABLES: ______

VOLATILES: ______

INORGANICS: ______

REMARKS: ______

[FOR EACH SAMPLE]

TABLE 6-9 STANDARD FORMAT WATER SUPPLY SAMPLE COLLECTION

ACS INC. LOGGED BY:

PRIVATE WELL SAMPLING

DATE: LOCATION:

FIELD SAMPLE NO.:

SAMPLERS:

WEATHER:

PUMP OPERATING STATUS: (RATE & DURATION)

TAP LOCATION:

TIME COLLECTION BEGAN: HRS

TIME COLLECTION ENDED: HRS

LOCATION DESCRIPTION:

SAMPLE DESCRIPTION:

FIELD MEASUREMENTS:

pH: standard units

SPEC. COND.: umhos/cm

TEMPERATURE: °C

METALS FIELD FILTERED: YES - NO

CUSTODY TAG NUMBERS

B/N/A EXTRCT:

PEST. & PCBs:

VOLATILES:

METALS:

CYANIDE:

MINERALS:

NUTRIENTS:

REMARKS:

- o The technician will package the samples for shipment making sure that all traffic reports, chain-of-custody records and custody seals are cross-referenced and that all sample documentation paper work is enclosed.

- o If samples are stored temporarily prior to shipment, they will be kept cool and placed in a secured storage area. Coolers will be sealed and custody seals affixed just prior to shipment.

The sample handling technician will maintain lists cross-referencing site sample numbers, custody tag numbers, traffic report numbers, analyses to be performed, custody seal numbers, shippers' airbill numbers, and consigned laboratories in a bound log book using black ink. (For detailed guidance on completing chain-of-custody and sample tracking paperwork, refer to "Sampling Handbook, U.S. EPA TAT, Region V, Revised 1985.")

SECTION 7

SAMPLING TEAM ORGANIZATION

The sampling team will consist of six individuals whose roles and responsibilities are as follows:

- Field Manager--responsible for overall execution of the field program and sampling plan; will coordinate and expedite drilling activities for the borings and monitoring well installations, test pit excavation, and other sampling activities; will coordinate procurements and communications.

- Site Safety Officer
responsible for implementation of the site safety plan as contained in the site evaluation form (SEF); will operate OVA and HNU instruments for screening of soil samples during drilling and test pitting activities activities; will direct a two-man sampling team during some of the other sampling activities.

- Sample Collectors (2) -- primarily involved in sample collection, may assist with decontamination and/or sample handling; will have the "dirty hands" during drilling and test pitting activities and when sampling with the supervisors or safety officers.

- Decontamination Technician--primarily involved in decontamination of sampling equipment and sampling team personnel, may assist with sample collection and/or sample handling.

- Sample Handling Technician--primarily involved in sample packaging and processing of sample custody and tracking paper work, may assist with decontamination.

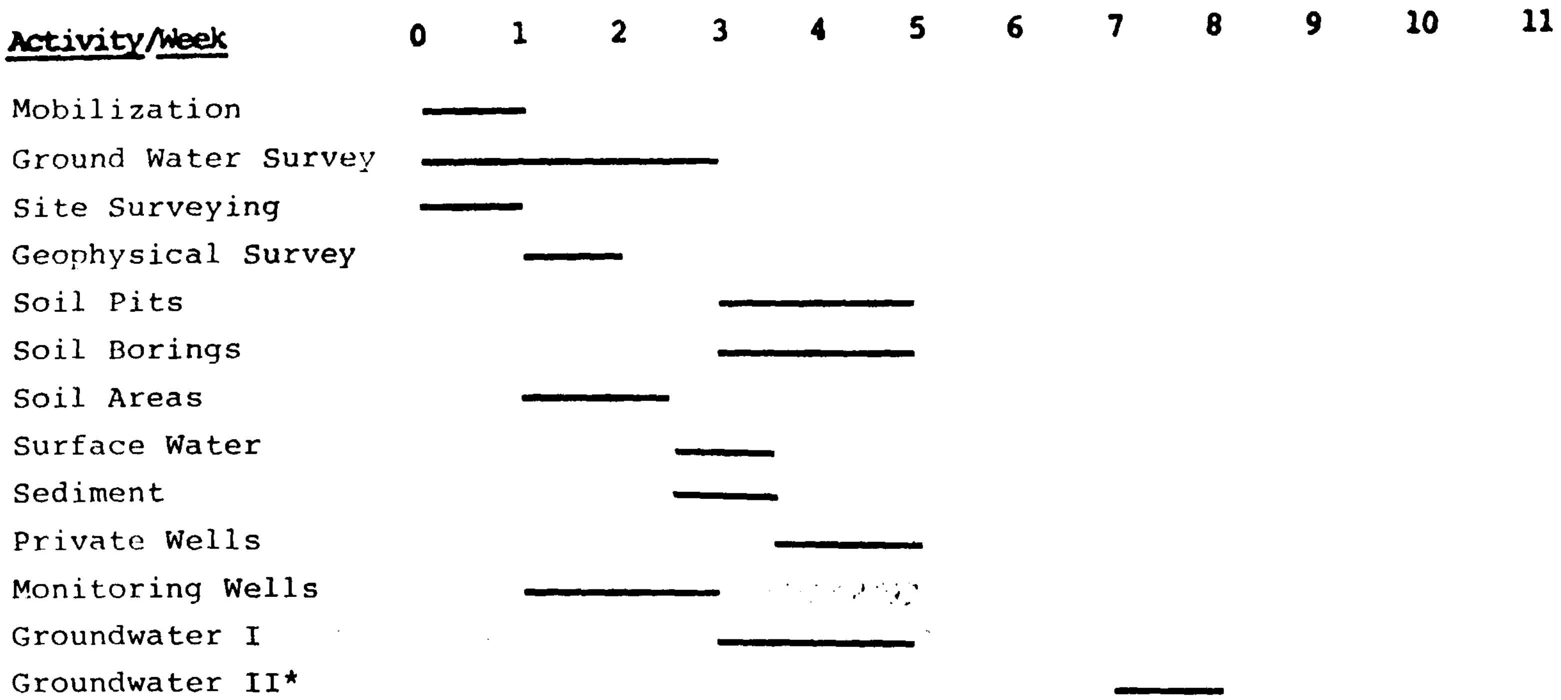
During boring and monitoring well installation activities, there will also be a driller and a helper from the firm subcontracted to provide drilling services present on site. During test pitting activities there will be an operator for the backhoe, and during geophysical surveying there will be an operator for the equipment.

SECTION 8

SCHEDULING

The schedule for this sampling plan is shown in Figure 8-1. Mobilization will require about five days. This includes setting up office and decontamination facilities and stockpiling materials and equipment. Boundary and grid surveying and geophysical work will last about two weeks. Test pitting, borings and other waste characterization activities are estimated to require two weeks to complete. Private well, surface water, surface soil and sediment sampling will require a four week period. Monitoring well installations are estimated at a total of about 10 working days, assuming two drilling rigs are used. Groundwater sampling is estimated at two weeks. The total duration of the primary field effort from the beginning of mobilization is 5 weeks. The second round of water supplies and groundwater sampling should only take one week, and is shown as occuring one month after the major field effort.

FIGURE 8-1
PHASE 1
SAMPLING PLAN SCHEDULE



*Note: Second round of Groundwater Sampling will occur one month after start of first round sampling.

Phase 2 schedule will be prepared based on the results of Phase 1.

APPENDIX A

Procedures for Field Measurement of pH, Specific Conductance and Temperature of Water Samples

Field Measurement of pH in Water

1. Scope and Application

This method is applicable to samples of stormwater, surface water, water supplies and groundwater with measurement occurring at the sampling location.

2. Summary of Method

The pH of water is determined using a portable, field pH meter with a temperature-compensated combination electrode.

3. Apparatus

A) Haake Buchler pH Meter Stick
B) 100 ml disposable beakers

4. Reagents

A) pH reference buffer solutions:

1) pH = 4.00 ±.01
2) pH = 7.00 ±.01
3) pH = 10.00 ±.01

B) distilled water

5. Sample Handling and Preparation

Sample aliquots for pH measurement should be obtained directly from the sampling point in 100 ml disposable beakers. Groundwater samples being tested during well purging can be obtained from the pump discharge line.

6. Calibration

Calibrate the meter/electrode using two reference solutions that bracket the expected pH of the sample. Reference solutions should be at room temperature. Immerse the electrode in pH 7.00 solution and adjust the meter as needed. Remove and rinse the electrode and repeat using the second buffer solution. Repeat adjustments until readings are within 0.05 pH units of the reference values.

7. Procedure

Immerse the electrode in the water while gently agitating. After about one-half minute, record the pH reading to the nearest 0.05 units -- provided the meter readings are not fluctuating more than ±0.03 units. Be sure that temperature compensation has been provided for. Remove and thoroughly rinse the electrode with distilled water. Repeat the measurement procedure until four readings have been obtained.

8. Interferences

Prolonged immersion of the electrode in turbid solutions can lead to plugging of the liquid junction and erratic meter readings. The electrode should be cleaned by gently blotting with a lab tissue and rinsing with distilled water.

9. Verification of Accuracy

Following the last of the four replicate measurements, immerse the rinsed electrode in each of the reference buffer solutions used to calibrate the meter/electrode prior to sample measurements. If the readings are not within 0.05 units of the reference values, recalibrate the meter/electrode and re-do the measurement of the sample just tested.

10. Assessment of Precision

Calculate the mean and standard deviation of the four replicate measurements. If the standard deviation is greater than 0.1 units, re-do the measurement of the sample just tested including calibration and verification.

11. Reporting

Report the average value of the replicate measurements to the nearest 0.1 units.

12. Preventative Maintenance

Preventative Maintenance will be performed in accordance with manufactures instructions.

Field Measurement of Specific Conductance and Temperature

1. Scope and Application

This method is applicable to samples of storamwater, surface water, water supplies and groundwater with measurement occurring at the sampling point.

2. Summary of Method

The specific conductance and temperature of water is determined using a portable, field conductivity meter having manual temperature compensation.

3. Apparatus

A) YSI Model 33 S-C-T Meter with weighted probe
B) 100 ml disposable beakers

4. Reagents

A) 0.01 N KCl reference solution
B) distilled water

5. Sample Handling and Preparation

Sample aliquots for specific conductance and temperature should be obtained directly from the sampling point in 100 ml disposable beakers. Groundwater samples being tested during well purging can be obtained from the pump discharge line.

6. Calibration

Calibrate the thermometer in the probe against the thermometer in the field laboratory. Readings should be within ± 1°C. Calibrate the specific conductance meter using the 0.01 N KCl reference solution. The specific conductance of this solution is 1413 umhos/cm at 25°C. Adjust the meter as needed. Temperature calibration should be performed weekly. Specific conductance calibration should be performed daily during the period of use.

7. Procedure

Check battery condition by turning selector dial to "Red Line". Adjust meter as needed. Immerse the probe in the beaker while gently agitating. Turn selector dial to "Temperature" and record temperature to nearest 0.5°C. Adjust manual temperature compensation dial to temperature of water. Turn selector dial to "Conductivity" at the scale range appropriate to sample conductance. Record specific conductance to three significant digits. Remove and thoroughly rinse the probe with distilled water. Repeat temperature and specific conductance measurements until four sets of readings have been obtained.

8. Assessment of Precision

Calculate the mean and standard duration of the four specific conductance measurements. If the standard deviation is greater than 5% of the mean, re-do the measurement of the sample just tested.

9. Reporting

Report the average values of the replicate measurements to the nearest 1°C for temperature and to three significant digits for specific conductance.

10. Preventative Maintenance

Preventative maintenance will be performed in accordance with manufactures instructions.

8. <u>Interferences</u>

Prolonged immersion of the electrode in turbid solutions can lead to plugging of the liquid junction and erratic meter readings. The electrode should be cleaned by gently blotting with a lab tissue and rinsing with distilled water.

9. <u>Verification of Accuracy</u>

Following the last of the four replicate measurements, immerse the rinsed electrode in each of the reference buffer solutions used to calibrate the meter/electrode prior to sample measurements. If the readings are not within 0.05 units of the reference values, recalibrate the meter/electrode and re-do the measurement of the sample just tested.

10. <u>Assessment of Precision</u>

Calculate the mean and standard deviation of the four replicate measurements. If the standard deviation is greater than 0.1 units, re-do the measurement of the sample just tested including calibration and verification.

11. <u>Reporting</u>

Report the average value of the replicate measurements to the nearest 0.1 units.

12. <u>Preventative Maintenance</u>

Preventative Maintenance will be performed in accordance with manufactures instructions.

Field Measurement of Specific Conductance and Temperature

1. Scope and Application

This method is applicable to samples of stormwater, surface water, water supplies and groundwater with measurement occurring at the sampling point.

2. Summary of Method

The specific conductance and temperature of water is determined using a portable, field conductivity meter having manual temperature compensation.

3. Apparatus

A) YSI Model 33 S-C-T Meter with weighted probe
B) 100 ml disposable beakers

4. Reagents

A) 0.01 N KCl reference solution
B) distilled water

5. Sample Handling and Preparation

Sample aliquots for specific conductance and temperature should be obtained directly from the sampling point in 100 ml disposable beakers. Groundwater samples being tested during well purging can be obtained from the pump discharge line.

6. Calibration

Calibrate the thermometer in the probe against the thermometer in the field laboratory. Readings should be within ± 1°C. Calibrate the specific conductance meter using the 0.01 N KCl reference solution. The specific conductance of this solution is 1413 umhos/cm at 25°C. Adjust the meter as needed. Temperature calibration should be performed weekly. Specific conductance calibration should be performed daily during the period of use.

7. Procedure

Check battery condition by turning selector dial to "Red Line". Adjust meter as needed. Immerse the probe in the beaker while gently agitating. Turn selector dial to "Temperature" and record temperature to nearest 0.5°C. Adjust manual temperature compensation dial to temperature of water. Turn selector dial to "Conductivity" at the scale range appropriate to sample conductance. Record specific conductance to three significant digits. Remove and thoroughly rinse the probe with distilled water. Repeat temperature and specific conductance measurements until four sets of readings have been obtained.

8. Assessment of Precision

Calculate the mean and standard duration of the four specific conductance measurements. If the standard deviation is greater than 5% of the mean, re-do the measurement of the sample just tested.

9. Reporting

Report the average values of the replicate measurements to the nearest 1°C for temperature and to three significant digits for specific conductance.

10. Preventative Maintenance

Preventative maintenance will be performed in accordance with manufactures instructions.

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